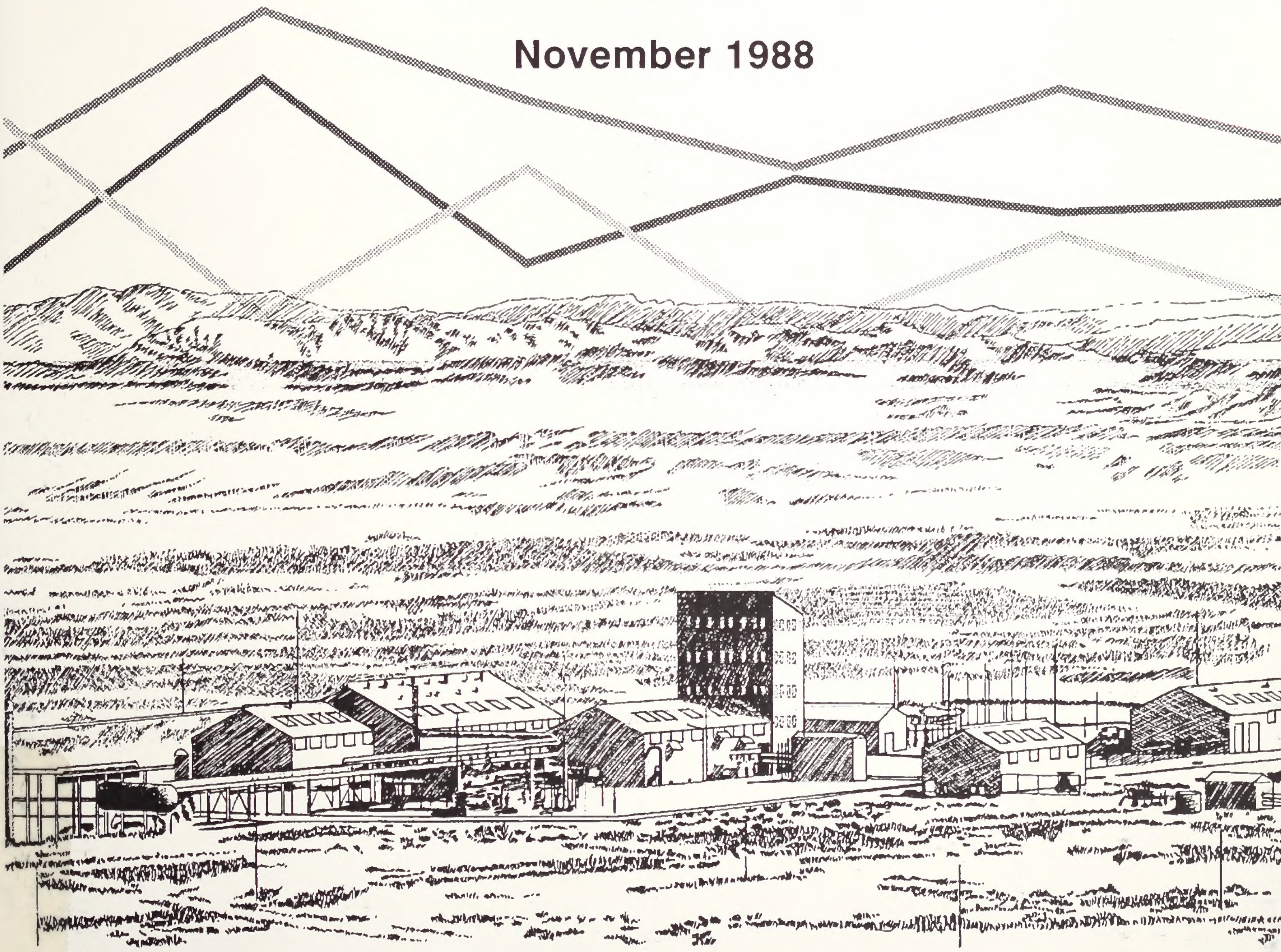
DEPARTMENT OF THE INTERIOR

DRAFT ENVIRONMENTAL IMPACT STATEMENT FOR THE

AMOCO CARBON DIOXIDE PROJECTS

November 1988



Prepared by Bureau of Land Management
State Director, Wyoming

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Hillary A. Oden

State Director, Wyoming

United States Department of the Interior

BUREAU OF LAND MANAGEMENT
WYOMING STATE OFFICE
P.O. BOX 1828
CHEYENNE, WYOMING 82003

TAKE PRIDE IN AMERICA

1793 (934)

Dear Reader:

This Draft Environmental Impact Statement, DEIS, has been prepared to analyze possible impacts from five proposed Amoco CO_2 projects within Wyoming for possible construction over the next six years. Four of the projects involve the use of carbon dioxide gas (CO_2) for enhanced oil recovery (EOR) purposes in existing Amoco oil fields. The fifth project consists of the development of a naturally occurring carbon dioxide source in southwestern Wyoming, near the Fontenelle Reservoir, to provide the quantities of CO_2 necessary to flood the four fields. A small portion of one field lies in Montana.

This draft EIS is prepared pursuant to the National Environmental Policy Act and the National Historic Preservation Act to address possible environmental and socioeconomic impacts which could result from the proposals and to solicit public comment and concerns.

We request that you make your comments as specific as possible. Remember that comments are most helpful if they suggest changes or provide sources or methodologies. Comments which contain opinions or preferences will not receive a formal response, but will be included as part of the BLM decision making process. The DEIS also serves as a request for any "interested persons" to identify themselves for the purpose of participating in the process of "protection of historic properties" as defined in 36 CFR 800.1(c)(2).

Comments on the DEIS should be submitted in writing and must be received no later than Friday, January 6, 1989. Your comments should be sent to the following address:

Bureau of Land Management
Casper District Office
1701 East E Street
Casper, WY. 82601
Attn. Glen Nebeker

Please retain this draft EIS for future reference, as the Final EIS, may be prepared in an abbreviated format. A copy of the FEIS will be sent to those persons who either received a copy of the draft or who commented on the draft EIS.

Sincerely,

Hillary A. Oden

State Director

Amoco Carbon Dioxide Projects
Environmental Impact Statement

(X) Draft ( ) Final

Lead Agency

U.S. Department of the Interior, Bureau of Land Management

Cooperating Agencies

U.S. Department of Army
Corps of Engineers
U.S. Bureau of Reclamation
U.S. Bureau of Indian Affairs

Counties That Could Be Affected

Wyoming
Big Horn, Carbon, Fremont, Hot Springs, Lincoln, Natrona, Park, Sweetwater and Washakie Counties

Montana
Carbon County

Abstract

The draft and final environmental impact statements (EISs) assess the environmental consequences of federal approval of the Amoco Carbon Dioxide Projects proposed by Amoco Production Company. Major project components are a CO_2 wellfield, gas gathering system and gas processing plant near Fontenelle, Wyoming; pipelines which would carry CO_2 from an existing Exxon pipeline to four operating oil fields (Elk Basin, Beaver Creek, Little Buffalo Basin and Salt Creek) for enhanced oil recovery in the fields; and gas recycle plants in each of the fields.

Based on the issues and concerns identified during the scoping process, the EIS focuses on impacts to socioeconomics, soils and reclamation, water resources and wildlife. The EIS analyzes direct and indirect impacts to various resources from the projects as well as cumulative impacts. Cumulative impacts are impacts that would occur from the Proposed Actions or alternatives plus other interrelated projects existing or planned for development in the area of influence during the analysis period. See the Summary in Chapter 2 for an overview of impacts that would occur from construction and operation of the projects.

DEIS Contact

Comments on this DEIS should be directed to:

Bureau of Land Management
Attention: Glen Nebeker
Casper District Office
1701 East E Street
Casper, Wyoming 82601
(307) 261-5101

Date DEIS Made Available to EPA and the Public

November 18, 1988

Date By Which Comments on the DEIS Must Be Received to be Considered in the Preparation of the Final EIS

January 6, 1989

SUMMARY

The purpose of this Draft Environmental Impact Statement (DEIS) is to analyze the potential environmental and socioeconomic consequences resulting from construction, operation, maintenance and abandonment of the five proposed Amoco CO_2 Projects. In addition, the DEIS explores reasonable alternatives to proposals made by Amoco. This DEIS is intended to inform the public of the possible impacts associated with the projects and aid the BLM in making a knowledgeable decision on whether to grant rights-of-way and other permits necessary for construction and operation of the following projects:

- FONTENELLE PROJECT:
  - Ten development wells in the Raptor CO_2 Field
  - 24.0 Miles of gas gathering system pipelines
  - 150 MMSCFD gas processing plant
- ELK BASIN PROJECT:
  - 178 Miles of CO_2 pipeline
  - 150 MMSCFD gas processing plant
- BEAVER CREEK PROJECT:
  - 43.9 Miles of CO_2 pipeline
  - 150 MMSCFD CO_2 recycle plant
- LITTLE BUFFALO BASIN PROJECT:
  - 35.5 Miles of CO_2 pipeline
  - 150 MMSCFD CO_2 recycle plant
- SALT CREEK PROJECT:
  - 9.2 Miles of CO_2 pipeline
  - 150 MMSCFD CO_2 recycle plant

The DEIS contains six chapters and four appendices. Chapter 1 provides an introduction to the document and states the purpose and need for Amoco's Proposed Actions. Chapter 2 contains descriptions of the Proposed Actions and their alternatives, providing a summary and comparison of the alternatives and identifies the BLM's Preferred Alternative. Chapter 3 describes the affected environment for each of the projects as well as alternatives. Chapter 4 analyzes the potential impacts to environmental and socioeconomic resources from the Proposed Actions and alternatives. Chapter 5 summarizes cumulative impacts, mitigation measures, unavoidable adverse impacts, short-term and long-term impacts and irreversible and irretrievable commitments of resources. Chapter 6 describes the preparation of the document including team organization, public scoping and consultation with individuals, organizations and government agencies.

Appendix 1 lists provisions and measures designed to reduce impacts. Appendix 2 documents compliance with the Endangered Species Act. A memorandum of understanding and roles and procedures for mitigation of potential impacts to cultural resources is contained in Appendix 3. Finally, Appendix 4 contains maps showing the approximate location of proposed and alternative pipeline alignments between the CO_2 supply and each field which would be flooded under Amoco's proposals.

To assist the reader, certain technical terms used in the DEIS have been defined in the glossary. These terms appear as italics in the text the first time they are used in each chapter. Abbreviations and acronyms are similarly defined in the glossary.

In addition to this DEIS, technical support documents have been prepared for each of the following resources:

- Socioeconomic Resources
- Wildlife and Aquatic Resources
- Transportation
- Soils, Vegetation and Agricultural Resources

o Mineral and Paleontological Resources

Technical support documents are available for review at the BLM Worland, Casper and Rock Springs district offices in Wyoming, the Wyoming State Office in Cheyenne, and the Miles City District in Miles City and Billings Resource Area offices in Billings, Montana.

All of the proposed CO_2 flood projects (Elk Basin, Beaver Creek, Little Buffalo Basin and Salt Creek) and their alternatives would have the same types of impacts because these impacts are a function of pipeline, recycle plant and wellfield construction activities common to them all. The significance of impacts is related to the type of environment into which the project is being introduced. Since all of the CO_2 flood projects would occur in developed oil fields with supply pipelines following existing pipeline corridors, the seriousness of the impact is reduced in all cases. Impacts differ among projects and between a proposed project and its alternative primarily because of the length of pipeline routes and the size (number of wells) in each targeted oil field.

The Amoco CO_2 Project would positively affect the development of oil resources and the economy of the project areas. The major adverse impacts of all projects would include land surface disturbance resulting in vegetation cover loss and, consequently, loss of wildlife and livestock forage and an increased potential for erosion. Wildlife will also be disturbed (during non-critical times) along the pipeline route and by wellfield and plant activities. Short-term degradation of water quality would occur at pipeline stream crossings. Minor air quality degradation is expected from fugitive dust and construction equipment emissions along the rights-of-way and in wellfields. Construction-related vehicles would increase traffic and are likely to cause accelerated deterioration of some roadways.

Both long- and short-term impacts to recreation, wilderness areas and visual resources can be expected due to noise of construction and visibility of the reclaimed pipeline alignment, but these impacts would be minor because of the location of all facilities adjacent to similar disturbances. Similar impacts to cultural resources (e.g., historic trails) would result from construction of all projects. Until Class III cultural surveys are conducted for all alignments, the extent of impact and required mitigation cannot be determined. Long-term impacts to cultural sites should be minor after mitigation measures are implemented.

Analysis in Chapter 4 indicates that the proposed CO_2 supply (i.e., the production of CO_2 from the Raptor Field with processing in the Fontenelle Gas Processing Plant) would disturb less than half the land (both in acreage and forage value) and only about 20 percent of the crucial deer and antelope winter range compared to using CO_2 from Phase II of Exxon's LaBarge Project. The Fontenelle Project is likely to disturb more moose and sage grouse habitat.

Fugitive dust and plant emissions are expected to be much higher from the Exxon facility. Any comparison of the Fontenelle Project to Exxon's Phase II LaBarge Project must, however, recognize that CO_2 production would not be the only product of the La Barge Project's Shute Creek Plant.

Alternatives to the Elk Basin and Salt Creek projects' pipelines (the Beaver Creek Alternative and Frontier/Casper Alternative alignments, respectively) would be similar to impacts of the Proposed Actions. Comparison of the Elk Basin and Beaver Creek trunk pipelines to the Beaver Creek Alternative route indicates that the Beaver Creek Alternative alignment is about 64 miles shorter, resulting in less soil and vegetation disturbance, less steep terrain affected, less forage lost and less wildlife habitat impacted. The Beaver Creek Alternative route

would also avoid the Sweetwater Rocks Wilderness Study Area vicinity.

Comparison of the Salt Creek and Frontier/Casper pipeline alignments indicates that even with the impacts of the Bairoil/Dakota Pipeline from milepost 185 to 221, the Salt Creek Project would generally have less environmental impact than the Frontier/Casper alignment. If, however, the Beaver Creek alignment is constructed rather than the Elk Basin Project, construction of the Salt Creek Project would require construction of the Bairoil/Dakota Pipeline from milepost 112 rather than only from milepost 185. This additional disturbance (73 miles) would far exceed the impacts of the Frontier/Casper alignment.

The BLM preferred alternative is to grant rights-of-way for the Proposed Actions conditional with minor alignment adjustments that would be addressed in the projects' Plans of Development after site-specific studies are completed.

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CHAPTER 1
INTRODUCTION

1.1 INTRODUCTION

The five projects evaluated in this Draft Environmental Impact Statement (*DEIS*) consist of a single CO_2 supply source (Fontenelle CO_2 Supply Project) and CO_2 floods in four existing Wyoming oil fields (Elk Basin CO_2 Project, Little Buffalo Basin CO_2 Project, Beaver Creek CO_2 Project and Salt Creek CO_2 Project). Each of the five projects are considered separate *Proposed Actions*. Amoco Production Company (Amoco) may decide, at a later date, to construct any combination of the five projects. Because the projects would be constructed in different locations throughout the state and the proposed construction schedules are staggered, no significant *cumulative impacts* are expected from the Proposed Actions (see Section 5.4).

The purpose of this DEIS is to evaluate the *impacts* associated with construction, operation, maintenance and abandonment of five separate projects proposed by Amoco. The five projects are being analyzed together in this DEIS because they all involve the application of *enhanced oil recovery* techniques through the use of carbon dioxide (CO_2) flooding.

The Proposed Actions represent Amoco's second step in an overall strategy to improve ultimate oil recovery from existing fields throughout the State of Wyoming. Amoco initiated its CO_2 strategy for the state in October 1986 with the injection of CO_2 into the Tensleep Formation at its Bairoil-Wertz Field located in Carbon and Sweetwater counties. Construction is presently ongoing to expand the CO_2 flood to the Bairoil-Lost Soldier Field. Although it will likely take numerous years to determine the economic success of the Bairoil CO_2 Project, preliminary results have been encouraging. Production from the Wertz Tensleep has nearly doubled since the start of CO_2 injection. A large portion of that incremental production is believed to be attributable to the CO_2 flood.

At this point, Amoco has made no commitments to construct any of the projects evaluated in this DEIS. Future commitments to construct the projects will be based on several factors including the completion of detailed engineering and reservoir studies to assure that CO_2 flooding in the fields is technically and economically feasible. Also, future oil prices and price stability will play key roles in Amoco's decisions regarding these projects.

Amoco submitted a right-of-way application to the Bureau of Land Management (*BLM*) to construct the 178-mile-long Elk Basin CO_2 trunk pipeline and CO_2 recycle plant on July 6, 1987. That application was subsequently amended by Amoco on September 2, 1987, to incorporate pipelines and plants associated with the Little Buffalo Basin CO_2 Project, Beaver Creek CO_2 Project, Salt Creek CO_2 Project and Fontenelle CO_2 Supply Project.

If all five projects and their associated primary project components are actually constructed, Amoco would be required to install approximately 266 miles of 16- and 18-inch CO_2 trunk and spur pipelines to supply CO_2 for the floods. These spur and trunk CO_2 pipelines would be capable of transporting between 150 and 200 million standard cubic feet per day (*MMSCFD*) of CO_2 from the Fontenelle supply source to the fields. In addition, implementation of the projects would require the construction of four CO_2 recycle plants (one for each of the CO_2 floods) and a CO_2 supply gas processing plant at the Fontenelle site. Each of these plants would be capable

of processing 150 MMSCFD of inlet feed gas.

The Raptor Field, the proposed CO_2 supply for the floods in the other four fields, has only a single exploratory well and the field has not been historically developed for oil or gas production. To develop CO_2 production from the Raptor Field, Amoco would be required to drill ten additional producing wells and install a gas gathering system to deliver field-produced CO_2 to the proposed Fontenelle Gas Processing Plant.

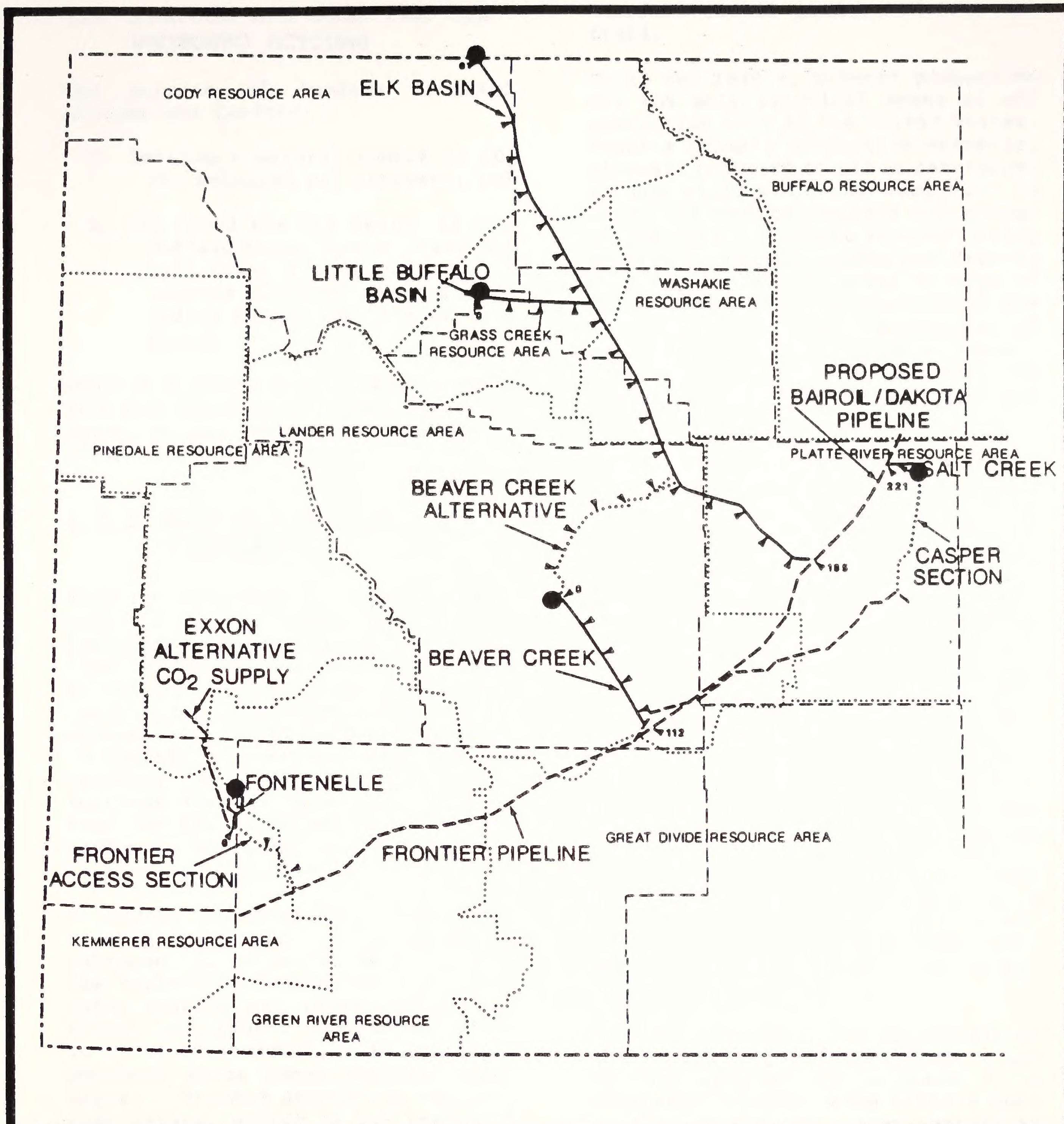
The four fields which Amoco has targeted for potential CO_2 flooding (Elk Basin, Beaver Creek, Little Buffalo Basin and Salt Creek) have been producing oil and gas for many years. In fact, the Salt Creek Field was discovered before the turn of the century. To pursue CO_2 flooding in these fields, Amoco may be required to replace or upgrade the existing injection and producing systems in the fields. The corrosive nature of CO_2 when mixed with water, combined with higher operating pressures projected during the CO_2 floods, may make some of the waterflood equipment presently being utilized in these fields inadequate.

Precise plans and locations for wellfield-related activities are not available at this time. In many cases, specific decisions regarding the replacement of wellfield equipment for each of the CO_2 floods cannot be made until further engineering and reservoir studies are conducted by Amoco. Therefore, specific impacts associated with individual wellfield-related activities are not analyzed on a case-by-case basis in this DEIS. Potential worst-case impacts associated with development within each of the fields are summarized for each project. However, complete analysis and *mitigation* of these impacts would be conducted outside the scope of this DEIS in supplemental environmental analyses. A Field Development Plan and/or a *Plan of Development* (POD) for each wellfield would address the specific details of each wellfield development and would include mitigation measures appropriate for the field. Where replacement of production and injection pipelines would be required, the POD would emphasize use of *corridors* to minimize field disturbance.

In addition to Amoco's Proposed Actions, this DEIS also evaluates alternative pipeline routes for the Elk Basin and Salt Creek pipelines. The Beaver Creek Alternative would require the construction of a CO_2 pipeline from the Beaver Creek Field north to Shoshoni, Wyoming, and connecting with the Elk Basin CO_2 trunk pipeline near Lost Cabin. The Frontier Alternative would convert the existing Frontier Oil Pipeline to CO_2 service and allow the transport of CO_2 from near Fontenelle Reservoir to Casper. The approximate locations of Amoco's Proposed Actions and alternative pipeline routes are provided on Figure 1-1 and on Maps 1 - 12 in Appendix 4.

Other alternatives included in this DEIS evaluate other possible CO_2 supply sources for the four flood projects. Included are analyses of non-natural sources such as power plant flue gas and the purchase of CO_2 from Exxon's LaBarge Project. Consistent with the National Environmental Policy Act, the No-Action Alternative, which evaluates the effects of denial of the rights-of-way, is also analyzed.

Design alternatives considered in this DEIS include the injection of sour CO_2 (CO_2 containing hydrogen sulfide) into the oil-producing formations at Elk Basin, Beaver Creek, Salt Creek and Little Buffalo Basin to supplement incremental oil recovery and to further reduce *emissions* of sulfur oxides (SO_2) from the recycle plants. Injection of sour CO_2 would eliminate the need for tail gas clean-up at the recycle plants.



BLM RESOURCE AREA BOUNDARY
PROPOSED PIPELINE ALIGNMENT
EXISTING FRONTIER PIPELINE
PROPOSED BAIROIL/DAKOTA PIPELINE
EXXON ALTERNATIVE CO_2 SUPPLY
COUNTY LINE
ALTERNATIVE PIPELINE ALIGNMENT
OIL OR CO_2 FIELDS
MILEPOST (10 MILES)

Figure 1—1. Location of Proposed and Alternative Pipeline Alignments.

1.2 PURPOSE AND NEED FOR THE PROPOSED ACTIONS

The purpose of Amoco's Proposed Actions are twofold:

1. Develop a natural source of CO_2 for enhanced oil recovery; and

2. CO_2 flood the Elk Basin, Little Buffalo Basin, Beaver Creek and Salt Creek fields with CO_2 to improve ultimate oil recovery and to extend the life of each field.

Amoco's Proposed Actions would comply with BLM resource management plans and county zoning ordinances (see Table 1-1).

1.2.1 Need For Enhanced Oil Recovery

Enhanced oil recovery is necessary in each of these fields because the fields are approaching their economic limit. The economic limit is defined as the point where production in the field drops to a level where it is economically infeasible to continue to operate the fields. Enhanced oil recovery in these fields would increase the ultimate oil recovered from the fields and would extend the number of years Amoco could continue to operate these fields.

A logical starting point when discussing why there is a need for enhanced oil recovery, is to examine the depletion of a typical oil field using primary and secondary oil recovery techniques. When an oil field is first discovered, it is typically produced using *primary production* techniques. Primary production recovery uses natural energy in the reservoir to raise the oil to the surface. Artificial lift equipment can be used to assist in production of oil during primary production. As natural reservoir energy is liberated during primary production, the reservoir pressure declines. Associated with the decline in reservoir pressure is a decrease in oil production from the field.

Until the 1930's, primary production was the only practical means of oil production used in the United States. Under a primary production scenario, ultimate recovery of oil is determined by the ability of the reservoir to naturally produce combined with economic factors. Ultimate recovery using primary production techniques depends on many factors including 1) type of reservoir shape, 2) properties of the reservoir rock, and 3) properties of the oil. Typically, primary production results in the recovery of approximately 15 percent of the *original-oil-in-place*.

Once the natural reservoir energy is sufficiently depleted, *secondary recovery* techniques, if economical, are usually employed. Secondary recovery involves the injection of a fluid into a reservoir to supplement the natural reservoir energy lost during primary production. The most common type of secondary recovery used by the oil industry in Wyoming is *waterflooding*. Waterflooding has advantages over other secondary recovery mechanisms. Water is relatively inexpensive to obtain and inject and it works quite well in displacing some crude oils from a reservoir. Waterflooding was first used over 100 years ago, but it was not until the 1950's that it gained popularity when full-scale field applications increased at a rapidly escalating rate. Waterflooding can result in the additional recovery of 25 percent of the original-oil-in-place.

The important point to be considered when discussing estimates of depletion of the original-oil-in-place in a reservoir is that, even after a successful waterflood, approximately 60 percent of the oil in the reservoir is left in the ground. That is, for every barrel of oil recovered using primary and secondary recovery techniques in a typical oil reservoir, two barrels remain locked in the ground.

Table 1-1. BLM Resource Area and County Land Use Policies and Regulations Related to Pipelines and Wellfields.

Resource Area or County	Utility Corridors/Rights-of-Way/Pipelines	Oil Fields or Major Industrial Developments
Billing (Montana) Resource Area	Numerous de facto corridors exist including major oil and gas pipelines and several highways. The resource area will apply corridor planning criteria for various exclusion areas, avoidance areas and windows.	Sixteen areas are identified as "sensitive" to oil and gas leasing. Special stipulations would be applied to leases within these areas. Standard stipulations would apply to other areas (which include the Elk Basin Fields).
Cody Resource Area	Areas that would be designated as utility and pipeline corridors would include existing right-of-way concentration areas, which would be the preferred corridors for placement of future pipeline rights-of-way.	Oil and gas reclamation plans would be prepared to improve reclamation in old fields throughout the planning area.
	The Bighorn River HMP/RAMP area would be designated a right-of-way avoidance area to protect wildlife, scenic and recreational values.	
	Significant segments of historic trails would be avoided for the placement of all types of rights-of-way. Where feasible, rights-of-way would be placed across trail routes in existing right-of-way crossing areas.	
	When rights-of-way would be required in avoidance areas or when the area could not reasonably be avoided, the effects of right-of-way construction would be intensively mitigated.	
Grass Creek Resource Area	Two utility corridors are designated: one of these follows WY 120 (northwest-southeast) from Meeteetse to Thermopolis, while the other runs north-south from the Greybull River near Greybull to Owl Creek, northwest of Thermopolis.	All lands in the resource area are open to mineral leasing, and protective stipulations will be applied to leases and contracts, as in the past, to mitigate environmental impacts.
Green River Resource Area	The resource area does not have designated utility corridors, although the area's management framework plan indicates that they should be established to minimize impacts of other resources.	The Management Framework Plan would not allow leasing on 5,280 acres, would lease 100,462 acres with no surface occupancy allowed, and would allow oil and gas leasing on the remaining land applying standard stipulations to open areas and special stipulations to sensitive areas

Table 1-1. Continued.

Resource Area or County	Utility Corridors/Rights-of-Way/Pipelines	Oil Fields or Major Industrial Developments
Kemmerer Resource Area	Preferred utility corridors have not been designated. The Wyoming-approved stipulations are to be used, as appropriate, to condition development activities in all programs where surface disturbing activities take place and where the objectives of the Resource Management Plan include the protection of important resource values. Four areas of "no surface occupancy" have been designated. None of these are in project areas. Existing road locations will be used where possible to minimize surface disturbances from pipelines and communication lines. Where possible, clearing of these rights-of-way will be accomplished with the least degree of disturbance to the topsoil.	All public lands within the resource area have been reviewed by the BLM and have been determined to be suitable for oil and gas leasing and development subject to certain stipulations. Resource management and protection stipulations will be developed and implemented on an "as needed" basis to prevent undue adverse impacts to other resource values.
Lander Resource Area	Major utility and transportation systems will be located to make use of existing corridors whenever possible, to provide for cost-effective routes and to provide for protection of other resource values such as scenery and wildlife. In the Beaver Creek Resource Management Unit, construction of major utility systems is allowed in all but three areas. One of these is the Oregon - Mormon Pioneer Trail corridor. Rights-of-way may be granted within this area if no feasible alternative route or designated corridor is available.	Oil and gas leases issued within the resource area are conditioned with stipulations to protect other important resource values. The Beaver Creek Field is open to oil and gas leasing with standard requirements.
Pinedale Resource Area	Corridors are considered preferred routes for transportation and transmission facilities which are compatible with existing uses inside the corridors. Identification of corridors does not preclude location of facilities in other areas if site-specific analysis indicates that such routes meet the overall plan objectives. One corridor is identified in the vicinity of the Exxon trunkline.	

Table 1-1. Continued.

Resource Area or County	Utility Corridors/Rights-of-Way/Pipelines	Oil Fields or Major Industrial Developments
Platte River Resource Area	Two designated corridors within the project areas are: U.S. Highway 20-26 and Wyoming Highway 259/U.S. 87 Future corridor adjustments and new corridor designations will be made only when facility placement within an existing designated corridor is incompatible, unfeasible, or impractical and when the environmental consequences can be adequately mitigated. Problems of technical compatibility between facilities and spacing of facilities in corridors will be solved case by case. Placement of rights-of-way will be restricted along the constructed segments of I-25 in T.37-40N., R.79-80W.	BLM-administered lands are open to oil and gas leasing and exploration subject to Wyoming BLM standard stipulations.
Washakie Resource Area	Existing transportation and utility corridors for roads, pipelines and power lines should be designated as right-of-way corridors, which would be the preferred locations for existing and future right-of-way grants. Areas classed as right-of-way avoidance areas include: o Potential threatened and endangered species habitat and wetland/riparian habitat; and o Semi-primitive nonmotorized ROS areas.	
Carbon County, Montana		Industrial utilization of land should be so planned and situated that it minimizes any potential adverse effects on surrounding areas. All efforts should be exerted to ensure that mining will exist harmoniously with other land uses.
Big Horn County	In locating rights of way, areas that should be avoided to the maximum extent possible include 1) irrigated lands, 2) potential reservoir sites, 3) floodplains, 4) excessive slopes and other unstable or erodible areas, and 5) important wildlife habitat areas.	In the Frannie-Deaver area, industrial and commercial development policies are concerned with maintenance of local environmental quality and preservation of water and agricultural lands.

Table 1-1. Continued.

Resource Area or County	Utility Corridors/Rights-of-Way/Pipelines	Oil Fields or Major Industrial Developments
Fremont County	Transportation and utility routes should, to minimize adverse environmental and aesthetic impacts, be combined whenever possible within common corridors.	Land areas particularly suitable for industrial development shall be identified and their reservation for such purposes strongly encouraged.
Hot Spring County	Major powerlines, pipeline and other transmission or transportation facilities shall, to the maximum extent practical, be located in existing transmission and transportation corridors.	
Lincoln County	Gas transmission pipelines and associated structures which are located on private land are classified as "Industrial II" uses, and require a Class I Permit if less than 800 square feet, and Class II if more.	Oil and gas development requires an Oil and Gas Location Permit.
Natrona County		Assure that future development will not adversely affect adjacent land use.
Park County		New construction should harmonize with the natural environment. Performance standards most applicable to the proposed projects would be: o Balance economic gains and environmental trade-offs by maintaining the character of the land being affected, avoiding adverse effects on irrigated farm land, and evaluating effects on community facilities and services, water and air quality, wildlife and scenic resources. o Publicize major proposed developments sufficiently in advance to allow citizens ample time to review and make constructive recommendations or propose alternatives to the proposal. o Encourage maintenance of current state and federal multiple use of public lands within the area.

Table 1-1. Continued.

Resource Area or County	Utility Corridors/Rights-of-Way/Pipelines	Oil Fields or Major Industrial Developments
Sweetwater County		Encourage industrial developments to locate in areas with the least potential for air, water and visual pollution. Encourage industrial development to locate near available public facilities, services and natural resources.
Washakie County	Transportation and utility rights-of-way should be grouped into corridors to the maximum extent possible. Such corridors should be planned with existing and potential land uses in mind and should help promote the most efficient use of the county's land.	

These remaining reserves are the target of Amoco's CO_2 Projects.

While the United States has only about 6 percent of the world's total population, we as a nation consume about 25 percent of all the world's energy including about 30 percent of the world's oil (Klins, 1984). Of the 460 billion barrels of oil discovered in the United States since 1859, present non-enhanced oil recovery production techniques (primary and secondary production) should result in the recovery of only about 148 billion barrels (about 32 percent). Conversely, when current fields in the United States are abandoned, some 312 billion barrels of oil (approximately 68 percent) will remain locked in the ground (Klins, 1984).

There are several types of enhanced oil recovery presently being used throughout the United States. Johnson (1982), estimated that existing enhanced oil recovery techniques could result in the addition of 18 to 53 billion barrels of oil to our domestic reserves (see Figure 1-2). Of the presently known enhanced oil recovery techniques, CO_2 flooding shows the widest applicability and will likely result in the largest incremental oil recovery. Pullman-Kellogg, Inc. (1978), in a comprehensive survey of sources of CO_2 for enhanced oil recovery, projected that between 5 and 10 billion barrels of oil could be produced by CO_2 flooding. Currently, the United States has about 27 billion barrels of reserves. Therefore, the additional amount of oil recoverable using enhanced oil recovery is significant. Further, Pullman-Kellogg, Inc. suggested that this incremental production may require upwards of 40 to 50 trillion standard cubic feet of CO_2.

Enhanced oil recovery, in particular CO_2 flooding, will play a very important role in the future of Wyoming's oil industry. Basko (1987), estimated that "Wyoming conservatively has 400 million barrels of recoverable enhanced oil." In Wyoming's case, that estimate is equal to about half of the state's current crude oil reserves. Amoco's existing (Bairoil) and proposed CO_2 floods alone could result in the incremental production of almost 200 million barrels of oil.

Enhanced oil recovery must be pursued while the existing wells and surface equipment are still intact and usable. Very few enhanced oil recovery prospects are projected to be so profitable that economics would allow redrilling of wells. Comparatively close economics for enhanced oil recovery projects will remain the rule rather than the exception because oil recoveries (as a percentage of original-oil-in-place) during enhanced oil recovery are expected to be substantially lower than during waterflooding and because investments and operating costs will be significantly higher. Most enhanced oil recovery projects are heavily front-end loaded with capital expenses for equipment necessary to transport, inject and produce CO_2.

1.2.2 CO_2 Enhanced Oil Recovery Overview

Carbon dioxide is a common, ordinary compound usually thought of as being a gas though it is quite easily converted to a solid or liquid. In its gaseous state, CO_2 is approximately 1.5 times heavier than air at standard conditions. For oil displacement, CO_2 typically is used in a gaseous state.

Characteristics of Carbon Dioxide

Gaseous carbon dioxide is used to carbonate beverages, as a weak acid in textile, leather and chemical industries, in water treatment, and in the manufacturing of aspirin and white lead, for hardening molds in foundries, in food preservation, in purging tanks and pipelines, as a fire extinguisher, in foams and in welding. Because it is relatively inert, it is utilized as a pressure medium. It is also used as a propellant in aerosols; medically as a respiratory stimulant,

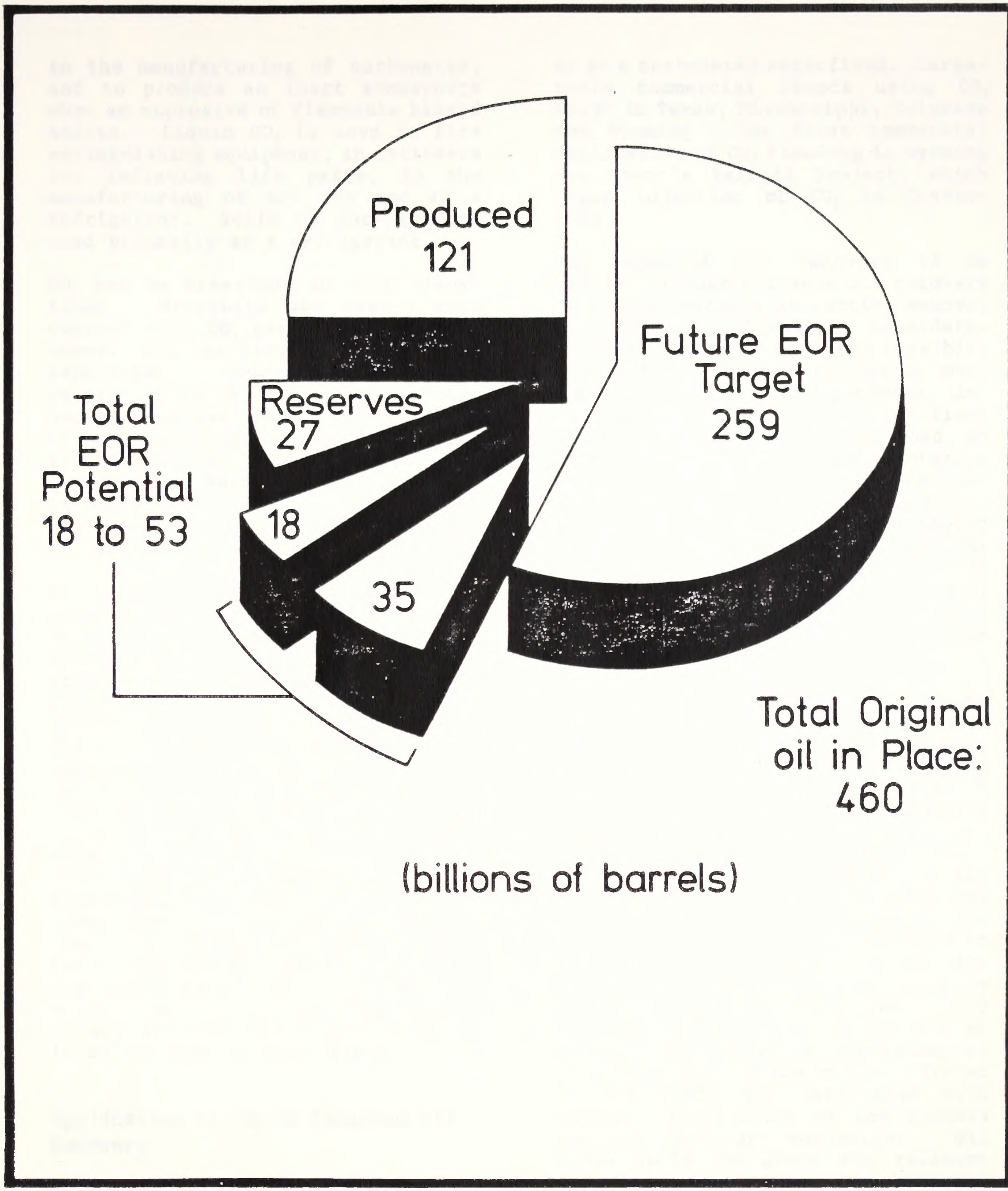


Figure 1—2. Domestic Oil Resources Available for Enhanced Oil Recovery (Johnson, 1982).

in the manufacturing of carbonates, and to produce an inert atmosphere when an explosive or flammable hazard exists. Liquid CO_2 is used in fire extinguishing equipment, in cylinders for inflating life rafts, in the manufacturing of dry ice and as a refrigerant. Solid CO_2 (dry ice) is used primarily as a refrigerant.

CO_2 can be hazardous in some situations. Frostbite may result from contact with CO_2 gas at low temperatures. CO_2 can also act as a simple asphyxiant. Concentrations of 10 percent (100,000 *ppm*) can produce unconsciousness from oxygen deficiency. A concentration of 5 percent (50,000 ppm) may produce shortness of breath and headache. Continuous exposure to 1.5 percent (15,000 ppm) may cause changes in some physiological processes (Sittig, 1981).

No criteria have been established for permissible concentrations of CO_2 in water (Sittig, 1981). The federal standard for permissible atmospheric exposure limits in air in the work place is 5,000 ppm (Occupational Safety and Health, October 1987). The short-term exposure limit, which represents the maximal concentration to which workers can be exposed for a period up to 15 minutes continuously without suffering adverse health affects, is 30,000 ppm (American Conference of Governmental Industrial Hygienist, 1987-88). The *IDLH* (immediately dangerous to life or health) concentration, which represents the maximum level from which one could escape within 30 minutes without an escape impairing symptom or any irreversible health effects, is 50,000 ppm (Sittig, 1981).

Application of CO_2 in Enhanced Oil Recovery

Injection of CO_2 to increase oil recovery is not a new idea. In 1952, Wharton et al. received the first patent for oil recovery using CO_2. Initially, Whorton et al. considered using CO_2 as a solvent for crude oil or as a carbonated waterflood. Large-scale commercial floods using CO_2 exist in Texas, Mississippi, Colorado and Wyoming. The first commercial application of CO_2 flooding in Wyoming was Amoco's Bairoil Project, which began injection of CO_2 in October 1986.

For enhanced oil recovery to be viable, it must increase oil recovery in an economically attractive manner. Currently, profitability considerations rather than technical feasibility restrict the application of most enhanced oil recovery projects, including CO_2 floods. Recent declines in world oil prices have had an adverse impact on the implementation of enhanced oil recovery. Economic attractiveness requires not only that the cost of implementing an enhanced oil recovery project be less than the value of resulting increased oil recovery, but also that the timing of the expenditures and revenues be such that an acceptable present value profit can be made.

Table 1-2 lists criteria developed by Klins (1984) for determining which reservoirs may be best suited for CO_2 flooding. Caution is warranted during the review of the criteria listed on Table 1-2. The method of applying binary screens like these is to compare the properties of a given reservoir to the threshold values in the screen. If the reservoir fails any single criterion, then, in theory, the process is considered inapplicable to the reservoir. In fact, not all fields proposed for CO_2 flooding by Amoco meet all the criterion listed by Klins in Table 1-2. While such an approach may be valid for technical screening, many of the criteria listed on the table are associated with economic feasibility of the process and are therefore subjective. Oil price would influence the relative importance of many of the criteria listed on the table.

CO_2 flooding has several advantages and disadvantages, including:

Table 1-2. Reservoir Criteria Used to Screen for CO2 Flooding Applicability (Miscible and Immiscible). (a)

Screening Parameter	CO2 Miscible	CO2 Immiscible
Viscosity, cp at reservoir conditions	<12	100 - 1,000
Gravity, API	>30	10 - 25
Fraction of oil remaining in area to be flooded (before EOR), % PV	25	50
Oil concentration, B/AF porosity x oil saturation	not critical	>600
Depth, feet	>3,000	>2,300
Temperature	not critical	not critical
Original bottomhole pressure psi,	>1,500	>1,000
Net pay thickness	not critical	not critical
Transmissibility	not critical	not critical
Comments	Thin pay preferred	Thin pay preferred
	High dip preferred	High dip preferred
	Homogeneous formation preferred	Homogeneous formation preferred
	No natural water drive	No natural water drive
	No major gas cap	No major gas cap
	No major fractures	No major fractures

a = Source: Klins, 1984.

Advantages:

- *Miscibility* can be attained at low pressures;
- *Displacement efficiency* is high in miscible cases;
- The process aids recovery by *solution gas drive*;
- CO_2 flooding is useful over a wider range of crude oils;
- Miscibility can be regenerated if lost.

Disadvantages:

- CO_2 is expensive to transport and not always available;
- Poor *sweep* and *gravity segregation* can result under certain circumstances;
- Corrosion is increased;
- Special handling and recycling of produced gas is necessary.

Besides an increase in reservoir pressure, the introduction of CO_2 into a reservoir has the following beneficial effects:

- Swells the oil;
- Reduces oil *viscosity*;
- Contributes to internal solution gas drive;
- Increases *injectivity*.

Swelling of oil: CO_2 is highly *soluble* in hydrocarbon oil. Depending on the saturation pressure, reservoir temperature and composition of the crude oil, approximately 700 standard cubic feet of CO_2 will dissolve in 1 barrel of 17° *API* crude oil, yielding a 10 to 30 percent increase in volume (Miller and Jones, 1981).

Oil swelling is important for two reasons. First, the residual oil left in the reservoir after waterflooding is inversely proportional to the swelling factor; that is, the greater the swelling, the less oil abandoned in the reservoir. Second, swollen oil droplets will force water out of the pore spaces in the reservoir rock, creating a drainage and a more favorable oil flow environment.

Viscosity reduction: The viscosity of a fluid is a measure of its resistance to flow. In the case of oil, certain generalizations regarding viscosity can be made. Viscosity decreases with increasing temperature and viscosity increases with increasing pressure. Viscosity also decreases as the gas in solution increases. As CO_2 gas saturates a crude oil, a large reduction in the viscosity of the oil occurs. This reduction can yield viscosities one-tenth to one-hundredth of the original viscosity. This viscosity reduction and its effect on oil mobility is more significant in medium and heavy oils and not as large in low viscosity oils.

Solution gas drive: Just as CO_2 goes into solution with an increase in reservoir pressure, gas will come out of solution and continue to drive oil into the wellbore. Reinjected gas will maintain the pressure in the gas cap which will keep most of the dissolved gas in the oil allowing higher production rates to be maintained. This mechanism of blowdown recovery is similar to solution gas drive during the primary production depletion of an oil field.

Increased injectivity: CO_2-water mixtures are slightly acidic. In shales, carbonic acid stabilizes clays due to a reduction in *pH*. In carbonates, injectivity is improved by partially dissolving the reservoir rock. The bicarbonates formed are quite soluble in water, which may lead to a *permeability* increase in carbonate rocks, especially around the wellbore where large volumes of CO_2 and water pass. This *dissolution* of carbonate material

may free unreacted reservoir fines to flow.

Flooding a reservoir with CO_2 utilizes the same types of equipment and processes installed during waterflooding. However, the increased injection and production pressures and corrosive nature of CO_2 mixed with water may require upgrading or replacement of systems installed to pursue waterflooding.

During the flood, CO_2 is injected into the reservoir through a series of injection wells (see Figure 1-3). For the Proposed Actions, CO_2 injection pressures in the fields would range between 1,200 and 2,200 pounds per square inch (*psi*). After a slug of CO_2 large enough to maintain a solvent bank between the CO_2 and oil is injected (approximately six months), a slug of water is introduced behind the CO_2. The alternating injection of CO_2 and water is referred to as a *WAG* process (water alternating gas). The water pushes the CO_2 slug and oil bank to producing wells where it can be recovered.

1.3 LOCATION

The five projects proposed by Amoco would be located in the following counties and Bureau of Land Management districts:

Project	County	BLM District
Fontenelle Project	Lincoln, Wy. Sweetwater, Wy.	Rock Springs
Elk Basin Project	Natrona, Wy. Fremont, Wy. Washakie, Wy. Hot Springs, Wy. Big Horn, Wy. Park, Wy. Carbon, Mt.	Casper Rawlins Worland Miles City
Beaver Creek Project	Fremont, Wy.	Rawlins
Little Buffalo Basin Project	Hot Springs, Wy. Washakie, Wy. Park, Wy.	Worland
Salt Creek Project	Natrona, Wy.	Casper

A map illustrating the approximate locations of various projects is presented on Figure 1-1.

1.4 AUTHORIZING ACTIONS

Amoco's Proposed Actions would require numerous permits, approvals and reviews of many aspects of project construction, maintenance, operation and abandonment. Table 1-3 lists permits, approvals and reviews necessary for aspects of the Proposed Actions.

To obtain a right-of-way grant from federal land management agencies or easements across state or private lands, several steps must be taken. For federally administered lands, an applicant must submit a right-of-way application to the appropriate federal agency along with a processing fee to cover the costs of processing the application and of granting and administering the rights-of-way. The agency prepares an environmental document (such as this DEIS) pursuant to the National Environmental Policy Act (*NEPA*) of 1969 to determine potential impacts on all lands (regardless of ownership) which may occur as a result of implementing the Proposed Actions. National Environmental Policy Act compliance for actions, such as wellfield-related activities, not specifically addressed in this EIS will be met by following the screening process as outlined in the 1791 BLM Manual.

Mitigation is proposed by the applicant as part of the project design. In addition to applicant commitments and mitigation, federal agencies require standard protective measures on federal lands. Appendix 1 contains measures that would be incorporated into the Plan of Development for the selected alternative.

After the final EIS is prepared, the Bureau of Land Management prepares a Record of Decision (*ROD*). The ROD documents and provides the legal record for any decisions the agency

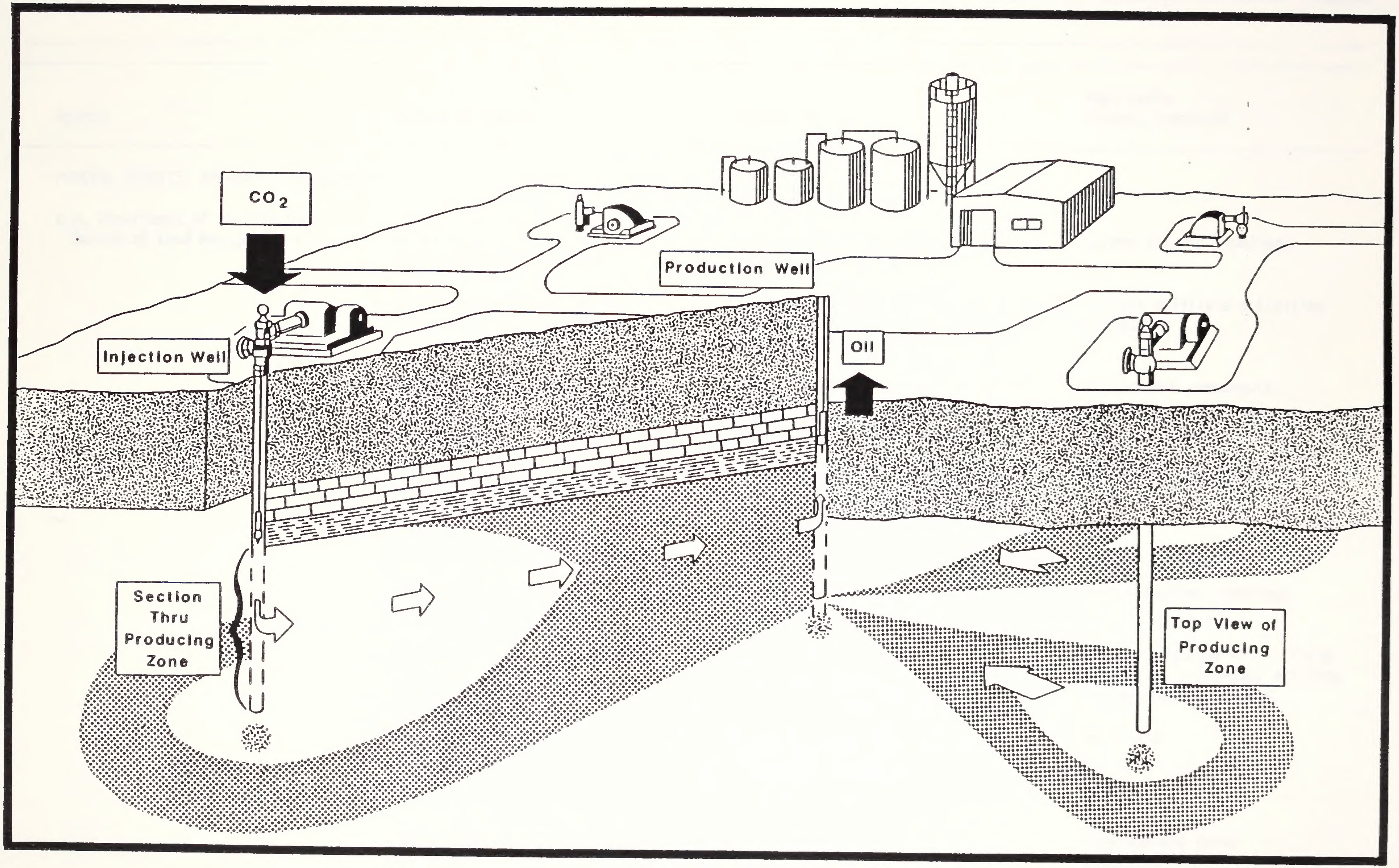


Figure 1—3. Cross Section of CO_2 Flood Process.

Table 1-3. Federal, State and Local Permits, Approvals and Reviews Necessary for Construction and Operation of Amoco's Proposed Carbon Dioxide Projects.

Agency	Nature of Action	Authority	Applicable Project Component
FEDERAL PERMITS, APPROVALS AND REVIEWS			
U.S. Department of the Interior Bureau of Land Management	Grant rights-of-way and issue temporary use permits	Section 28 of the Mineral Leasing Act of 1920	Carbon dioxide pipelines
	Grant rights-of-way and issue temporary use permits	Title V, Section 501, of the Federal Land Policy and Management Act (1976)	Certain wellfield activities and plants
	Issue materials sales contracts	Materials Act of 1947, as amended; 30 U.S.C. 601, 602, 43 CFR 3600	All project components
	Issue antiquities and cultural resource use permit to excavate or remove cultural resources on federal lands	Antiquities Act of 1906, 16 U.S.C. Sections 431-433; Archaeological Resources Public Protection Act of 1979, 16 U.S.C. Sections 470aa-47011; 43 CFR Part 3	All project components
	Issue permits to cross federal-aid highways	23 U.S.C. Sections 116, 123, 23 CFR Part 645 Subpart B	Carbon dioxide pipelines
	Approval of APDs, completion, workovers, well repair and H2s contingency plan	Mineral Leasing Act, 43 CFR Part 3160	Well pad, access roads, field pipelines, subsurface drilling and production actions
	Approval to dispose of produced water	Mineral Leasing Act, 43 CFR Part 3160; Federal Land Policy and Management Act, Title V, Section 501	Wellfield
	Approval of off-lease oil measurement		Pipeline and lease production

Table 1-3. Continued.

Agency	Nature of Action	Authority	Applicable Project Component
Bureau of Indian Affairs	Grant rights-of-way on trust lands	62 Stat. 17; 25 U.S.C. and Title 25, CFR Part 169	Carbon dioxide pipelines
Bureau of Reclamation	Grant special land use license or easement	Reclamation Projects Act of 1939, 35 Stat. 1189, and Section 10	Carbon dioxide pipelines
U.S. Fish and Wildlife Service	Consultation process for endangered or threatened species	Endangered Species Act; 16 U.S.C. 1531 et seq.	All project components
U.S. Department of the Army Corps of Engineers	Issue Section 404 permit for placement of dredged or filled material in waters of the United States or their adjacent wetlands	Section 404 of the Clean Water Act of 1972 (40 CFR 122-123); 33 U.S.C. Section 1344; 33 CFR Parts 323, 325	Carbon dioxide pipelines
	Issue Section 10 permit for crossing navigable waters in the United States	Section 10 of the Rivers and Harbors Act of 1899, 33 U.S.C. 401-413	Carbon dioxide pipelines
U.S. Department of the Treasury Bureau of Alcohol, Tobacco and Firearms	Issue permits to purchase, store and use explosives	Section 1102(a) of the Organized Crime Control Act of 1970, 18 U.S.C. Sections 841-848; 27 CFR Part 181	All project components
STATE OF WYOMING			
Department of Environmental Quality - Air Quality Division	Issue air quality construction and operating permits	Wyoming Environmental Quality Act, W.S. 35-502-101 through 35-502-1207	Plants
Department of Environmental Quality - Water Quality Division	Issue National Pollution Discharge Elimination System Permit for discharges	Wyoming Environmental Quality Act, W.S. 35-11-301	Certain wellfield activities and carbon dioxide pipelines

Table 1-3. Continued.

Agency	Nature of Action	Authority	Applicable Project Component
	Permit to construct and install a wastewater facility	W.S. 35-11-101 through 1207	Plants
	Underground injection permit for plant wastewater	W.S. 35-11-101 through 1104	Plants
	Permit to construct sediment retention ponds	W.S. 35-11-101 through 1104	Plants and certain wellfield activities
Wyoming Highway Department	Issue permits for oversize and overweight loads	Chapters 17 and 20 of the Wyoming Highway Department Rules and Regulations	All project components
	Issue encroachment permits	Chapter 12 of the Wyoming Highway Department Rules and Regulations	All project components
State Land Board	Issue easements to cross state lands	W.S. 35-20 and 36-20	Carbon dioxide pipelines and certain wellfield activities
Wyoming Oil and Gas Commission	Change in depletion plans	Wyoming Oil and Gas Act; W.S. 30-5-110	Wellfield activities
	Underground injection permit for carbon dioxide	Safe Drinking Water Act and W.S. 35-5-101 and 30-5-303	Wellfield activities
Wyoming State Engineer's Office	Grant permit to appropriate water for hydrostatic testing	W.S. 41-121 through 147	Carbon dioxide pipelines
LOCAL			
County Commission	Road crossing permits		Carbon dioxide pipelines

may make regarding the requested rights-of-way on federal lands.

After the ROD is released, the applicant must refile the right-of-way application to reflect any changes in the route that were specified in the ROD. The applicant also has the opportunity at this point to notify the Bureau of Land Management whether it wants the right-of-way or not. If the applicant did not want the right-of-way because of changed plans, the Bureau would not issue the right-of-way grant. If the applicant requested the right-of-way several years later, the Bureau would review the EIS and supporting documentation to evaluate whether updating was necessary prior to granting the right-of-way. Necessary updates would occur if the socioeconomic or physical environment had changed enough to modify impacts assessed in the original EIS.

Before a right-of-way can be granted, an applicant must prepare a Plan of Development (POD) covering construction of all project facilities on federal land. This POD must be submitted to the authorizing agencies for approval. The POD would contain site-specific construction, maintenance, operations and abandonment procedures for the following areas of concern, specified for the types of terrain, soils, vegetation, land use and climatic conditions encountered in the project area:

- Engineering Proposals and Construction Drawings
- Fire Protection
- Clearing
- Erosion Control, Revegetation and Restoration
- Water Resources
- Transportation
- Communications
- Cultural Resources
- Threatened or *Endangered Plant and Animal Species*
- Wildlife Mitigation
- Blasting
- Pesticide and Herbicide Use
- Health and Safety
  - Solid Waste
  - Emergency Response
  - Air Quality
  - Spill Prevention Control and Counter Measures
- Construction Schedule
- Housing and Construction Facilities
- Testing (pipeline)
- Monitoring of Construction
- Operations and Maintenance
- Abandonment

Before construction begins, an applicant may be required to conduct surveys for endangered or *threatened species*; cultural, *historical*, and paleontological resources; and nests of federally protected raptors. The Bureau of Land Management then applies stipulations to the construction activities to protect site-specific resources.

The process used by pipeline companies to obtain easements across private lands is different from that used for state or federal lands. The company's right-of-way agent first contacts the landowner for permission to have a surveyor determine the pipeline centerline across the owner's property. At the same time, the right-of-way agent seeks the landowner's permission to conduct the same surveys required to obtain permits to cross federal and state lands (such as cultural surveys).

A plat is prepared after the surveyor obtains the necessary data for locating the pipeline within the boundaries of each landowner's property. This plat shows the relationship of the pipeline to the property boundaries. The right-of-way agent again meets with the landowners to initiate negotiations for an easement across the property. When the parties are in agreement, the landowner will sign the easement and the right-of-way agent will have it recorded in the County Clerk's office.

Across federal, state and private lands, Amoco has requested a 50-foot-wide permanent easement, with an additional 25-foot-wide temporary construction permit for spur and trunk CO_2 pipelines. Construction tech-

niques and rehabilitation procedures would be the same on private lands as those used on comparable federal and state lands, or as the landowner requires.

CHAPTER 2
ALTERNATIVES INCLUDING THE PROPOSED ACTIONS

2.1 INTRODUCTION

The purpose of Chapter 2 of this *DEIS* is to describe the *Proposed Actions* including construction techniques, design considerations and operating practices. The discussion in this chapter provides a technical overview of the various types of equipment, facilities and processes necessary to pursue *enhanced oil recovery* in the Elk Basin, Little Buffalo Basin, Beaver Creek and Salt Creek fields. Also included is a description of the equipment and facilities necessary to produce and transport *CO_2* from the Raptor Field and to process field production. The chapter also describes alternatives to the Proposed Actions, presents a summary table of *impacts* and presents the *BLM* preferred alternative.

Information in this chapter is preliminary and it is possible that decisions regarding certain pipeline, plant and field processes may change as more detailed economic, engineering and reservoir studies are completed by Amoco. To assure that all impacts are adequately considered in this DEIS, and given the need for further refinement of project design by Amoco, the DEIS analysis is based on reasonable "worst-case" assumptions. In other words, impacts presented in this DEIS are described for the maximum, reasonable production scenarios--refinements in the design could result in less severe impacts than identified in the DEIS.

2.2 PROPOSED ACTIONS

2.2.1 Proposed CO_2 Supply

Amoco proposes to supply CO_2 for the floods through the development of its Raptor Field as a natural CO_2 source. The Raptor Field is located in Sweetwater and Lincoln counties near Fontenelle Reservoir in T.24 and 25 N., R.112 W. This township is defined on the north by American Quasar's Fontenelle Unit No. 35-22 well and on the south by Amoco's Raptor Unit No. 1 well. Both wells have produced inert gas with 90 percent plus CO_2 content at strong rates from the Madison Formation at depths in the range of 15,000 feet. The locations of the Raptor Field and proposed Fontenelle Plant site are provided on Figure 2-1 and Map 1 in Appendix 4.

Gas from the Raptor Field has several distinct advantages as an economical CO_2 source for enhanced oil recovery. Raptor CO_2 is somewhat unique in that the only processing steps necessary to produce pipeline quality CO_2 for enhanced recovery are dehydration and hydrogen sulfide (*H_2S*) removal. To process the Raptor gas, Amoco proposes to construct a gas plant capable of processing up to 150 *MMSCFD* of inlet feed gas from the Raptor Field. The Fontenelle Plant would be constructed adjacent to the existing Exxon Shute Creek Plant. The process will include dehydration with triethylene glycol and selective removal of H_2S (about 1.05 percent) to produce 96 percent purity CO_2. The acid gas waste stream from the plant would be reinjected into the Madison Reservoir at the plant site in strict compliance with Wyoming Department of Environmental Quality regulations.

Development of the Raptor Field would require the installation of a gas gathering system to transport CO_2 from individual wells in the field to the gas processing plant. In addition, ten development wells would be drilled within the Raptor Field. CO_2 from the Fontenelle Gas Processing Plant would be delivered to the origin stations of the Elk Basin, Beaver Creek and Salt Creek pipelines via existing and/ or approved sections of the Bairoil/

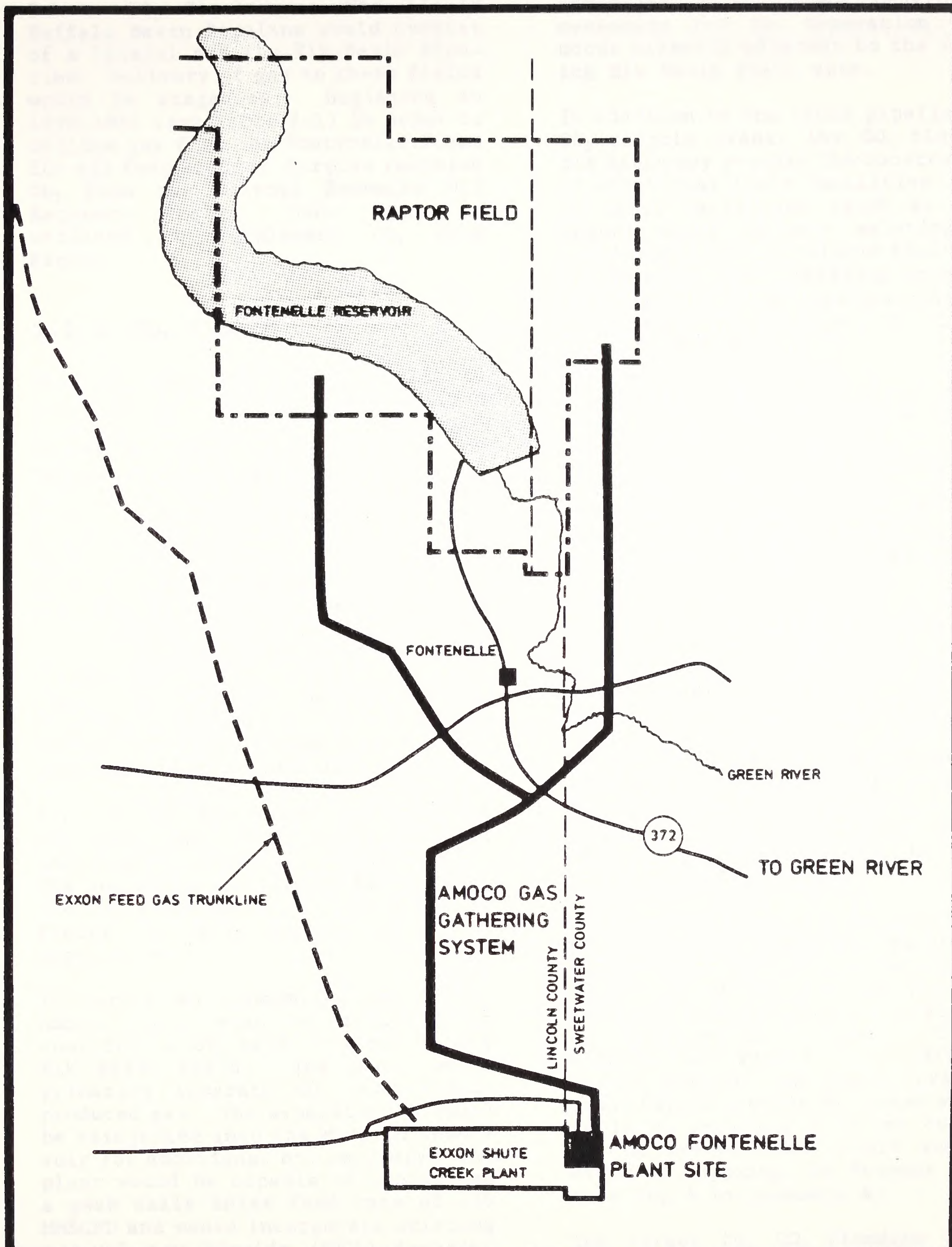


Figure 2—1. Proposed Fontenelle Project.

Dakota CO_2 Pipeline. The Little Buffalo Basin Pipeline would consist of a lateral off the Elk Basin Pipeline. Delivery of gas to these fields would be staggered, beginning in 1990-1994 (see Table 2-1) in order to utilize gas from the Fontenelle Plant for all four floods. Surplus recycled CO_2 from the Bairoil Enhanced Oil Recovery Project could also be utilized to supplement CO_2 from Raptor.

2.2.2 CO_2 Floods

The Elk Basin Project would be supplied by a 178-mile-long, 18-inch diameter CO_2 trunk pipeline originating at Powder River, Wyoming, in Natrona County at approximately milepost 185 of the Bairoil/Dakota Pipeline. The Bairoil/Dakota Pipeline from mileposts 112 to 185 would also have to be constructed (Appendix 4, Maps 10 - 11). BLM has completed an EIS for this right-of-way, but the right-of-way will not be granted until an applicant reapplies and impacts are re-evaluated (BLM, 1985a). At that time, the relative merits of the Proposed Action route, the Crooks Gap Option and other routes avoiding the Sweetwater Rocks could be reassessed. From the origin, the CO_2 trunk pipeline would be routed in existing pipeline *corridors* to the Elk Basin Field near Powell, Wyoming, in Park County. The locations of the Elk Basin Field and CO_2 trunk pipeline are shown on Figure 2-2 (also see Maps 2 - 5 in Appendix 4).

To pursue an economical CO_2 flood, Amoco would also be required to construct a CO_2 recycle plant in the Elk Basin Field. The plant would primarily separate CO_2 from field-produced gas. The separated CO_2 would be reinjected into the Madison Reservoir for additional oil recovery. The plant would be capable of processing a peak daily inlet feed rate of 150 MMSCFD and would incorporate existing natural gas liquids (*NGL*) treating facilities presently available in Amoco's existing Elk Basin Plant. All additional recycle plant construction necessary for CO_2 separation would occur directly adjacent to the existing Elk Basin Plant site.

In addition to the trunk pipeline and CO_2 recycle plant, the CO_2 flood at Elk Basin may require the construction of additional field facilities. Most of these facilities (such as wellheads) would replace existing and similar waterflood-related facilities in the field. The existing injection and producing flowlines installed for *waterflooding* may be adequate for the CO_2 flood at Elk Basin.

The Elk Basin Field produces from four separate horizons at depths ranging from 1,500 to 6,000 feet. The Mississippian age Madison limestone, at 5,000 feet, is the field's primary candidate for enhanced oil recovery. Amoco operates the Elk Basin Field with working interests that vary by formation.

The Elk Basin Field is presently being depleted under a secondary oil recovery strategy (waterflooding). Implementation of the CO_2 flood could recover an estimated 65 million additional barrels of oil. This incremental oil would not be recoverable through continued waterflooding. In addition to the incremental oil, minor amounts of incremental gas, natural gas liquids and sulfur may be recovered from the CO_2 flood.

A 44-mile-long, 18-inch diameter trunk pipeline would supply the Beaver Creek Project with CO_2. The trunk pipeline would originate at milepost 112 of the existing Bairoil/Dakota CO_2 Pipeline in southeastern Fremont County, Wyoming (see Figure 2-3). From the origin station, the Beaver Creek CO_2 Trunk Pipeline would be routed entirely in an existing pipeline corridor to the Beaver Creek Field south of Riverton, Wyoming, in Fremont County (see Map 6 in Appendix 4).

The target for CO_2 flooding in the Beaver Creek Field would be the Tensleep and Madison formations at depths of 10,500 to 11,500 feet,

Table 2-1. Proposed Construction Schedule for Major Components of the Amoco Carbon Dioxide Projects.

Project	Trunk and Spur Pipelines		Plants		Wellfield-Related Activities		Initiate Carbon Dioxide Injection
	Start	Complete	Start	Complete	Start	Complete	
Fontenelle Project	N/A		2nd Qtr 1989	4th Qtr 1990	2nd Qtr 1989	3rd Qtr 1990	N/A
Elk Basin Project	2nd Qtr 1990	4th Qtr 1990	2nd Qtr 1990	3rd Qtr 1991	2nd Qtr 1989	4th Qtr 1990	4th Qtr 1990
Beaver Creek Project	2nd Qtr 1992	3rd Qtr 1992	1st Qtr 1992	2nd Qtr 1993	2nd Qtr 1991	4th Qtr 1992	3rd Qtr 1992
Little Buffalo Basin Project	2nd Qtr 1993	3rd Qtr 1993	1st Qtr 1993	2nd Qtr 1994	2nd Qtr 1992	3rd Qtr 1993	3rd Qtr 1993
Salt Creek Project	2nd Qtr 1994	3rd Qtr 1994	4th Qtr 1993	4th Qtr 1994	4th Qtr 1993	4th Qtr 1997	4th Qtr 1994

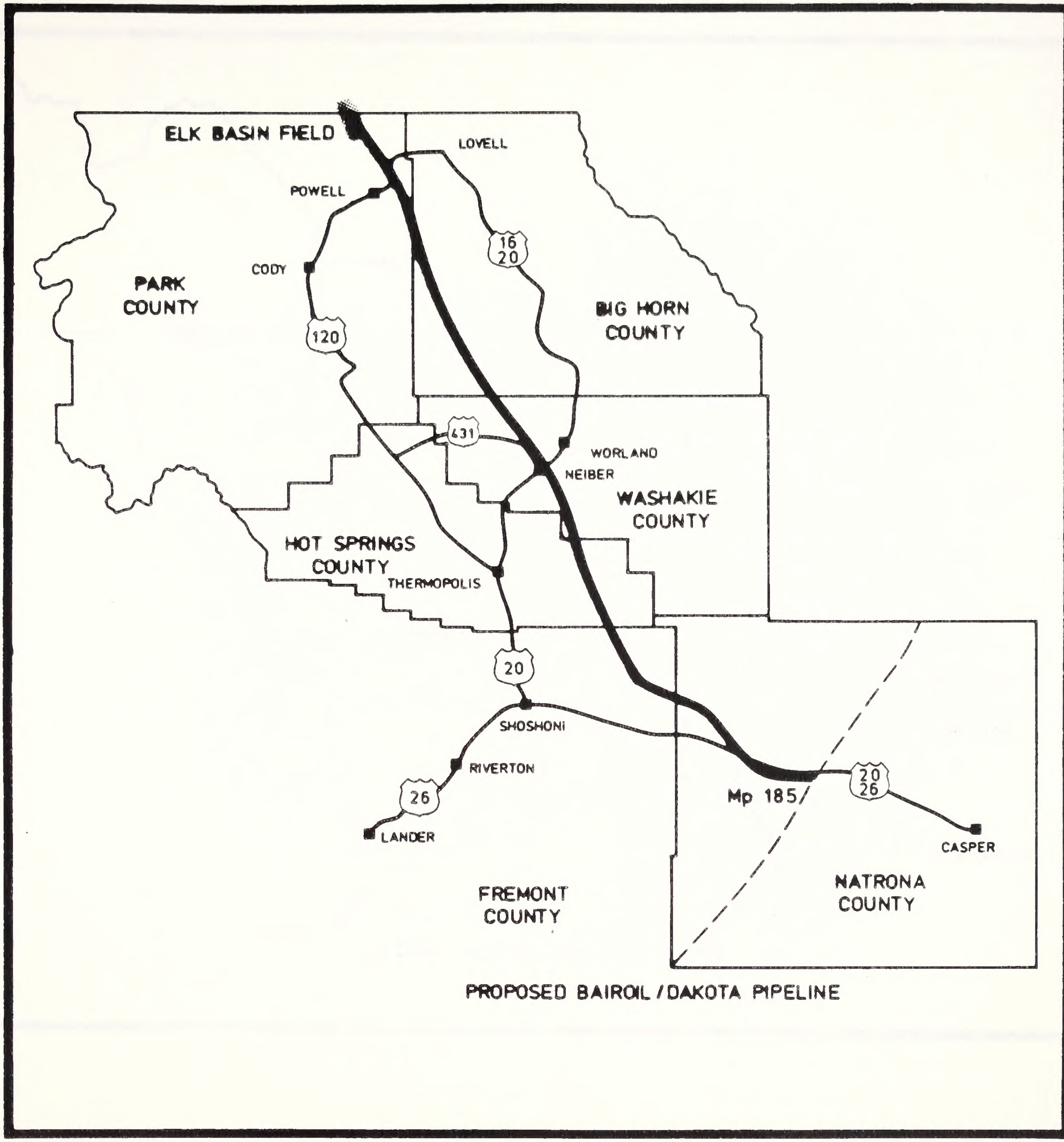


Figure 2—2. Proposed Elk Basin Project.

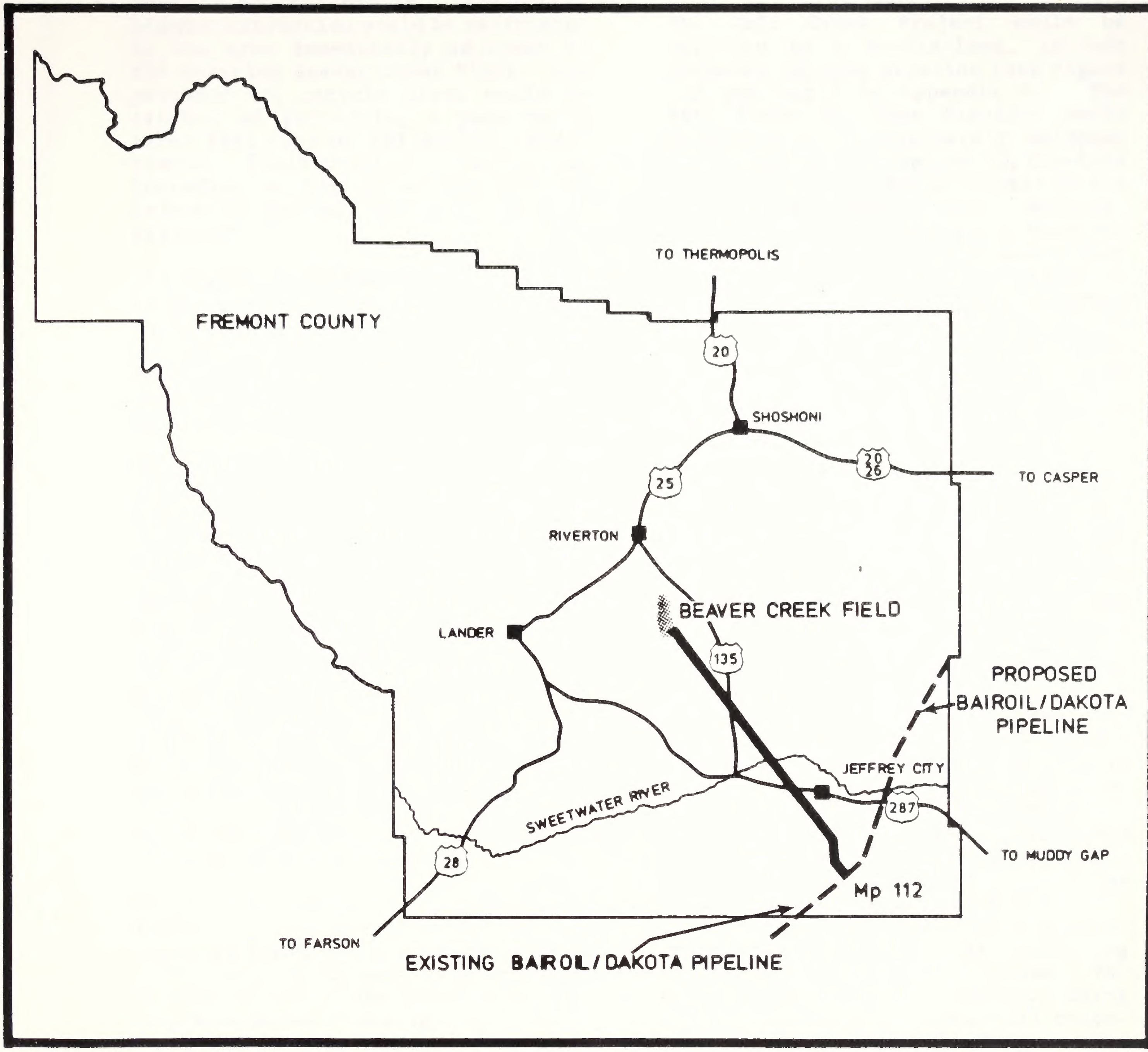


Figure 2—3. Proposed Beaver Creek Project.

respectively. Amoco would incorporate existing Beaver Creek Plant NGL treating facilities in the field in the overall project design. Additional plant construction would be restricted to the area immediately adjacent to the existing Beaver Creek Plant. The proposed CO_2 recycle plant would be capable of processing a peak daily inlet feed rate of 150 MMSCFD. Additional field-related facilities, including a gas gathering and CO_2 injection system, may also be constructed.

The Beaver Creek Tensleep is presently being depleted using *primary production* techniques. The Madison Reservoir is currently under a mature waterflood. Implementation of the CO_2 flood would recover approximately 30 million barrels of incremental oil.

The Little Buffalo Basin Project would be supplied by a 35-mile-long, 16-inch diameter spur pipeline. The approximate locations of the Little Buffalo Basin Field and spur pipeline are shown on Figure 2-4 (also see Map 7 in Appendix 4). The Little Buffalo Basin Spur Pipeline would originate at approximately milepost 77 of the Elk Basin CO_2 Trunk Pipeline north of Neiber, Wyoming, in Washakie County. From the origin point, the Little Buffalo Basin Spur Pipeline would follow an abandoned pipeline corridor and State Highway 431 to the Little Buffalo Basin Field south of Meeteetse, Wyoming, in Park and Hot Springs counties, Wyoming.

The target formation in the Little Buffalo Basin Field would be the Tensleep Formation at a depth of about 4,700 feet. A CO_2 recycle plant would be constructed in the field to facilitate economical flooding of the field. The plant would be capable of processing a peak daily inlet feed rate of 150 MMSCFD. Additional field-related facilities, including a gas gathering and injection system, would also be constructed.

The Little Buffalo Basin Field is presently being depleted through waterflooding. Implementation of the CO_2 flood would allow the incremental recovery of an estimated 15 million barrels of additional oil.

The Salt Creek Project would be supplied by a 9-mile-long, 16-inch diameter CO_2 spur pipeline (see Figure 2-5 and Map 8 in Appendix 4). The Salt Creek CO_2 Spur Pipeline would originate at approximately milepost 221 of the Bairoil/Dakota CO_2 Pipeline in Natrona County and terminate in the Salt Creek Field near Midwest, Wyoming. The Bairoil/Dakota Pipeline from milepost 112 to 221 would have to be built before implementation of the Salt Creek Project (see Appendix 4, Maps 10 - 11). As indicated in the discussion of the Elk Basin Project, impacts of the construction from mileposts 112 - 221 would be reassessed before a right-of-way were granted.

Production from the Salt Creek Light Oil Unit presently occurs from six horizons at depths ranging from 1,200 to 2,900 feet. The primary target for CO_2 flooding in the Salt Creek Field would be the 2nd Wall Creek Sandstone Formation at 1,800 to 3,500 feet. Design of the Salt Creek Project would include a CO_2 recycle plant to separate CO_2 from field-produced gas. Separated CO_2 would be recycled and reinjected into the 2nd Wall Creek Formation. The plant would be capable of processing a peak daily inlet feed rate of 150 MMSCFD. Implementation of a CO_2 flood in the Salt Creek Field would require construction of a CO_2 recycle plant. Implementation of the flood would also require the construction of additional field-related facilities including a gas gathering system and CO_2 injection system. The Salt Creek Field is presently being produced under a secondary oil recovery strategy (waterflooding). Implementation of the CO_2 flood could recover an estimated 50 million barrels of incremental oil.

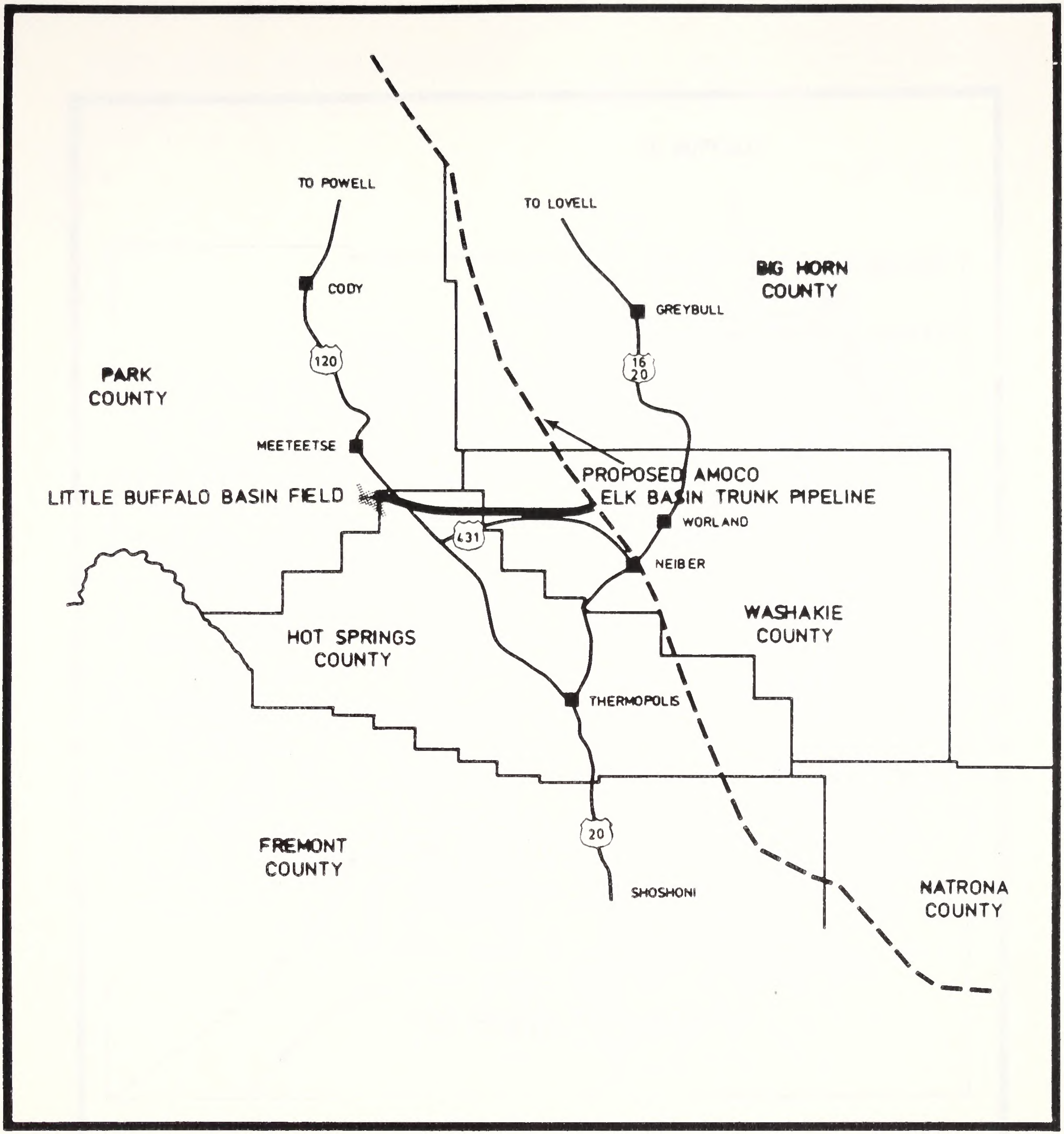


Figure 2-4. Proposed Little Buffalo Basin Project.

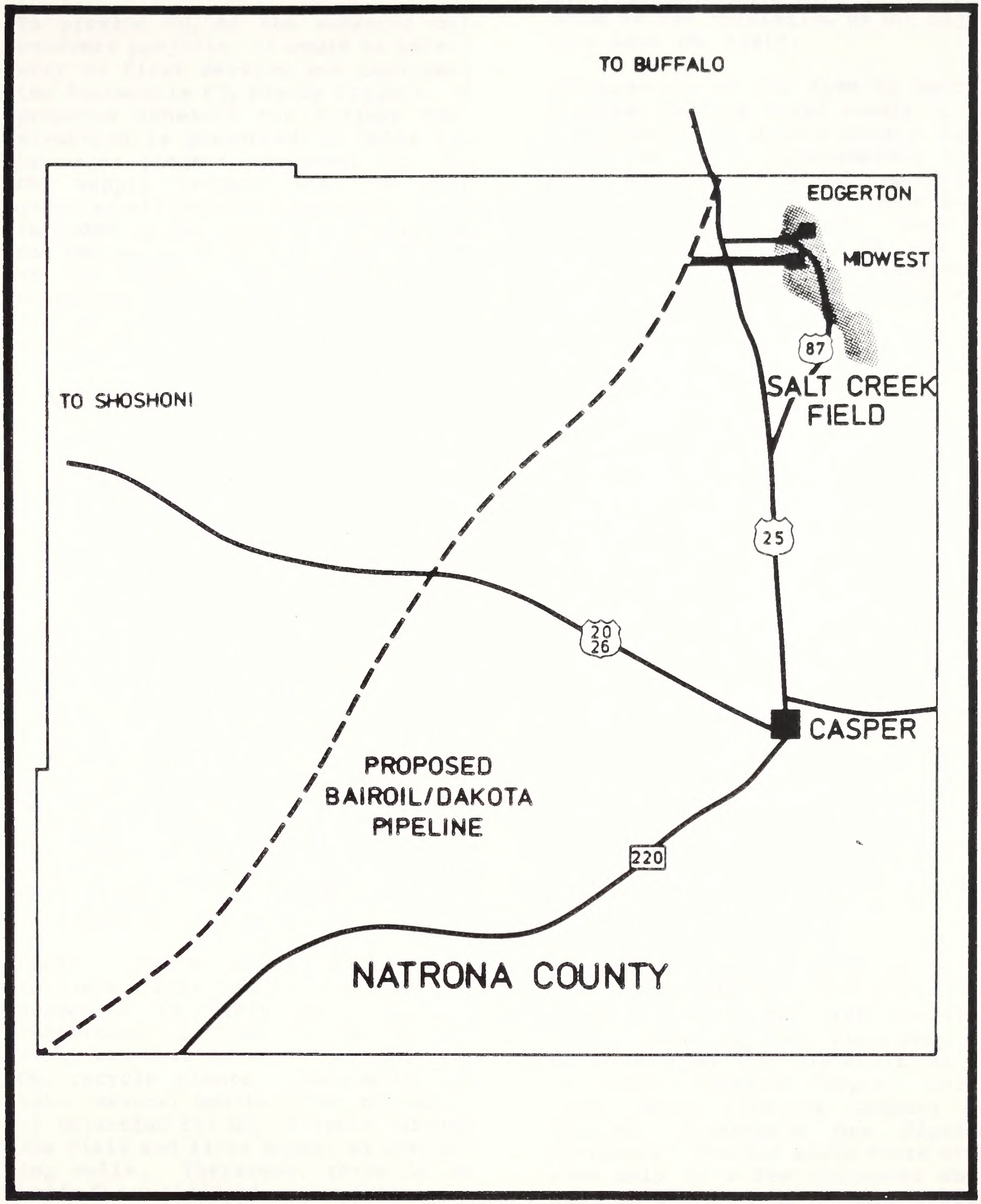


Figure 2—5. Proposed Salt Creek Project.

2.2.3 Steps, Phases And Timing

To provide CO_2 to the enhanced oil recovery projects, it would be necessary to first develop and construct the Fontenelle CO_2 Supply Project. A proposed schedule for project construction is presented on Table 2-1 by major project component for the CO_2 supply project and the four enhanced oil recovery projects. Also included on the table is a projection for the start of CO_2 injection in each of the fields. In general terms, construction would be initiated for each project according to the following schedule:

- o Fontenelle Supply Project - 2nd quarter 1989;
- o Elk Basin Project - 2nd quarter 1989;
- o Beaver Creek Project - 2nd quarter 1991;
- o Little Buffalo Basin Project - 2nd quarter 1992;
- o Salt Creek Project - 4th quarter 1993.

Construction of all CO_2 trunk and spur pipelines for a given project would be completed during a single construction season starting in the spring of a given year, with completion scheduled for year's end. For the Elk Basin CO_2 Trunk Pipeline, completion of construction in a single construction season would require the use of two construction spreads. Construction of the plants would follow initiation of wellfield-related construction activities.

Careful review of Table 2-1 will indicate that CO_2 injection is scheduled to begin prior to the completion of construction of all wellfield-related activities and the CO_2 recycle plants. Generally, it takes several months after the start of injection for CO_2 to cycle through the field and first appear at producing wells. Therefore, there is no need for wellfield and plant construction completion to coincide with the initiation of CO_2 injection. Obviously, however, construction of the CO_2 supply source and CO_2 trunk and spur pipelines must be complete prior to the initiation of CO_2 injection into the field.

Construction of all five of Amoco's Proposed Actions would result in the disturbance of approximately 3,450 acres, of which approximately 3,035 acres would be reclaimed immediately after construction (see Table 2-2). Approximately 412 acres would be converted to industrial use for the life of the projects. All disturbance would be reclaimed after abandonment.

2.2.4 Location, Extent and Land Ownership

Amoco's proposed CO_2 projects would be constructed in southwest, central and north central Wyoming. Counties potentially affected during construction of project components are listed in Section 1.3 of this DEIS. If all five projects are constructed, Amoco would install approximately 266 miles of spur and trunk CO_2 pipelines and five gas processing or CO_2 recycle plants. Under the worst case scenario, approximately 700 miles of CO_2 injection and producing pipelines may need to be installed or replaced in the existing Elk Basin, Beaver Creek, Little Buffalo Basin and Salt Creek fields. In addition, development of the Raptor Field would require the installation of approximately 24 miles of gas gathering pipeline, 30 miles of wellfield pipeline and the drilling of ten additional wells.

Construction of the majority of the spur and trunk CO_2 pipelines would occur in existing pipeline corridors. The Elk Basin CO_2 Trunk Pipeline would be constructed entirely within existing Platte Pipeline Company, Interline, Amoco Pipeline Company and Colorado Interstate Gas Pipeline corridors. The Elk Basin route deviates only in a few instances where the pipeline was intentionally rerouted away from existing corridors to avoid significant cultural sites and *wilderness study areas*. The Beaver Creek

Table 2-2. Acres Disturbed, Removed and Reclaimed During Construction and Operation of the Proposed Actions.

Project/Component	Acres Disturbed During Construction	Acres Reclaimed After Construction	Acres Committed To Operations	Acres Reclaimed After Abandonment
FONTENELLE PROJECT				
Plant Site	40.0	0.0	40.0	40.0
Plant Access Road (a)	18.2	0.0	18.2	18.2
Field Access Roads (b)	181.8	0.0	181.8	181.8
Well Pads (c)	100.0	90.0	10.0	10.0
Gas Gathering System (d)				
Pipeline (d,e)	491.4	491.4	0.0	0.0
Block Valves (f,g)	0.2	0.0	0.2	0.2
Green River Staging Area (h)	2.3	2.3	0.0	0.0
Road Crossing Bore Pits (i)	2.3	2.3	0.0	0.0
Gathering System Subtotal	496.2	496.0	0.2	0.2
Project Total	836.2	586.0	250.2	250.2
ELK BASIN PROJECT				
Trunk Pipeline				
Trunk Pipeline (e)	1623.5	1623.5	0.0	0.0
Block Valves (g)	0.9	0.0	0.9	0.9
Origin Station	0.1	0.0	0.1	0.1
Meter Station	0.2	0.0	0.2	0.2
Big Horn River Staging Area (j)	2.3	2.3	0.0	0.0
Greybull River Staging Area (j)	2.3	2.3	0.0	0.0
Shoshone River Staging Area (j)	2.3	2.3	0.0	0.0
Sidon Canal Bore Pit (k)	1.1	1.1	0.0	0.0
Road Crossing Bore Pits (i)	5.7	5.7	0.0	0.0
Pipeline Subtotal	1638.5	1637.3	1.2	1.2
Plant Site	40.0	0.0	40.0	40.0
Project Total	1678.5	1637.3	41.2	41.2
BEAVER CREEK PROJECT				
Trunk Pipeline				
Trunk Pipeline (e)	399.9	399.9	0.0	0.0
Block Valves (g)	0.2	0.0	0.2	0.2
Origin Station	0.1	0.0	0.1	0.1
Meter Station	0.2	0.0	0.2	0.2
Sweetwater River Staging Area (j)	2.3	2.3	0.0	0.0
Road Crossing Bore Pits (i)	2.3	2.3	0.0	0.0
Pipeline Subtotal	404.9	404.4	0.5	0.5
Plant Site	40.0	0.0	40.0	40.0
Project Total	444.9	404.4	40.5	40.5
LITTLE BUFFALO BASIN PROJECT				
Spur Pipeline				
Spur Pipeline (e)	322.6	322.6	0.0	0.0
Block Valves (g)	0.2	0.0	0.2	0.2
Origin Station	0.1	0.0	0.1	0.1
Meter Station	0.2	0.0	0.2	0.2
Road Crossing Bore Pits (i)	3.4	3.4	0.0	0.0
Pipeline Subtotal	326.5	326.0	0.5	0.5
Plant Site	40.0	0.0	40.0	40.0
Project Total	366.5	326.0	40.5	40.5
SALT CREEK PROJECT				
Spur Pipeline				
Spur Pipeline (e)	84.1	84.1	0.0	0.0
Block Valves (g)	0.1	0.0	0.1	0.1
Origin Station	0.1	0.0	0.1	0.1
Meter Station	0.2	0.0	0.2	0.2
Road Crossing Bore Pits (i)	1.1	1.1	0.0	0.0
Pipeline Subtotal	85.6	85.2	0.4	0.4
Plant Site	40.0	0.0	40.0	40.0
Project Total	125.6	85.2	40.4	40.4
Total of all five Projects	3451.6	3039.0	412.6	412.6

a = 3 miles of access road @ 50'.
b = Assumes 3 miles of access road/well @ 50'.
c = 10 wells @ 10 acres/well for drilling purposes and 1 acre/well during operations.
d = Assumes 3 miles of gathering system/well plus gas gathering trunkline to plant.
e = Assumes 75' right-of-way.
f = Includes block valves on each side of Green River crossing.
g = Block valves would occupy 1/10 acre.
h = 200' x 400' less pipeline right-of-way on each side of river.
i = 200' x 200' less pipeline right-of-way on each side of state highway crossings.
j = 200' x 400' less pipeline right-of-way on each side of river.
k = 200' x 200' less pipeline right-of-way on each side of canal.

Trunk Pipeline would be constructed entirely in an existing Northern Natural Gas Pipeline corridor from the origin point to the Beaver Creek Field. Since Class III cultural surveys have not been conducted for the Beaver Creek Trunk Pipeline, minor deviations away from the Northern Natural Gas Pipeline may be necessary to avoid additional cultural sites.

The Little Buffalo Basin CO_2 Spur Pipeline would be constructed in a series of corridors, including an abandoned pipeline and State Highway 431. The Salt Creek CO_2 Spur Pipeline was generally routed along an existing dirt road from the origin station to the field. No existing east-west pipeline corridors occur in the vicinity of the proposed Salt Creek Pipeline alignment.

Land ownership of the proposed plant sites is federal. Ownership along the pipeline corridors is a mixture of federal, private and state. Federal lands occupy 61.9 percent of all pipeline corridors with 32.7 percent consisting of private lands and 5.4 percent State of Wyoming (see Table 2-3).

2.3 ALTERNATIVES

Council on Environmental Quality rules implementing *NEPA* requires the BLM to "rigorously explore and objectively evaluate all reasonable alternatives, and for alternatives which were eliminated from detailed study, briefly discuss the reasons for their having been eliminated" (40 *CFR* 1502.14(a)). In addition, the analysis is required to "devote substantial treatment to each alternative considered in detail including the Proposed Action so that reviewers may evaluate their comparative merits" (40 CFR 1502.14(b)).

Three types of alternatives exist for Amoco's Proposed Actions: 1) alternative sources of CO_2 for the floods, 2) alternative alignments for CO_2 spur and trunk pipelines and 3) the No Action Alternative.

2.3.1 Alternative Sources of CO_2 for the Floods

Many industrial activities and processes result in the production of CO_2 which, in most cases, is vented to the atmosphere as a waste by-product of the industrial facility. Significant sources of CO_2 include:

- Power plant stack gases;
- Flue gases from cement plants;
- Vent gases from ammonia and chemical plants;
- Vent gases from refinery and hydrogen plants;
- Vent gases from proposed synthetic natural gas plants.

In addition to industrial sources, natural sources of CO_2 are also available for enhanced oil recovery. Natural sources of CO_2 are abundant in Wyoming. Klins (1984) estimated Wyoming natural CO_2 reserves at approximately 3,900 *BCF*. Since Klins published his estimate, discoveries of additional CO_2 (as much as 20 *TCF*) have been made by Exxon at LaBarge. Given the amount of excess CO_2 in Wyoming, it is likely that Wyoming will become an important source of CO_2 for enhanced oil recovery in the near future.

According to the Pullman-Kellogg study, power plants in Wyoming may be able to provide as much as 1,400 MMSCFD of CO_2. Cement plants and process plant sources may yield an additional 350 MMSCFD. The study also suggested that total CO_2 demand in the state may reach 3,900 BCF.

Amoco's CO_2 Projects are very sensitive to CO_2 price. For the projects to proceed, a reliable source of low-cost CO_2 must be developed. Factors influencing the costs include gas purity and location of supply. CO_2 is expensive to transport and therefore, location of the source has a direct bearing on the combined cost of the commodity to Amoco. High purity CO_2 sources, such as ammonia plant vents and synthetic natural gas plants command a higher price for CO_2

Table 2-3. Summary of Land Ownership for Proposed Pipelines.

Pipeline	Miles Private	Miles Federal	Miles State	Total Miles	Percent Private	Percent Federal	Percent State
Fontenelle Gas Gathering System	0.5	23.5	0	24.0	2.0%	98%	0%
Elk Basin Trunk Pipeline	66.8	97.8	13.8	178.4	37.4%	54.8%	7.7%
Beaver Creek Trunk Pipeline	9.3	33.2	1.4	43.9	21.1%	75.6%	3.3%
Little Buffalo Basin Spur Pipeline	14.4	20.5	0.5	35.5	40.7%	57.8%	1.5%
Salt Creek Spur Pipeline	4.0	5.3	0	9.2	43.2%	56.8%	0%
Total	95.0	180.3	15.8	291.0	32.7%	61.9%	5.4%

than low purity sources like flue gas stacks, power plants and cement plants (Pullman-Kellogg, 1978).

Power Plant Stack Gas. Pullman-Kellogg (1978), in a comprehensive review of CO_2 supply in a thirteen-state region which included Wyoming, indicated that sufficient CO_2 is available from aboveground sources to satisfy the projected future demand for enhanced oil recovery. Power plant and cement plant stack gas sources are the most widespread and abundant aboveground sources. However, the quality of CO_2 produced from these sources is typically very low, less than 20 percent CO_2. Therefore, purification costs associated with these alternatives sources would be expected to be relatively high.

Amoco has determined that the most economical source of CO_2 for the CO_2 projects is naturally occurring CO_2. No commercial source of CO_2 from power plant stack gas is presently available in Wyoming and it appears unlikely that such a source will be developed in the near future given the abundant quantities of CO_2 available from natural sources. For these reasons, power plant flue gas as a source of CO_2 for the Amoco CO_2 Projects has not been considered further in the DEIS.

Underground Coal Gasification. Recently, Energy International announced its intention to construct and operate an underground coal gasification project near Rawlins, Wyoming. Funding for this project includes assistance from the U.S. Department of Energy and the Clean Coal Technology program.

Initially, Energy International had intended to convert underground coal gasification product gas into ammonia. A by-product of operation of the ammonia plant would have been CO_2. However, the company has had difficulties in obtaining matching funds from the private sector to proceed with the ammonia project. At this time, Energy International is reevaluating the project to determine if it is technically and economically feasible to change the underground coal gasification portion of the project to produce a CO_2-based product gas stream instead of the methane-based stream initially included in the overall project design.

If a cost competitive source of CO_2 can be developed by Energy International, it could be tied to Amoco's proposed Beaver Creek and Elk Basin trunk pipelines located approximately 50 miles north of the Energy International project area. However, funding for this type of project is still questionable and no commitments have been made by Energy International to proceed with the project, at this time.

Because of the economic and technical uncertainty of development of Energy International's Underground Coal Gasification Project, it has not been considered as a source of CO_2 for Amoco's projects for purposes of preparing this DEIS.

Exxon LaBarge Project. Phase II of Exxon's LaBarge Project could also serve as a CO_2 supply for Amoco's projects. Presently, Exxon is providing CO_2 for Amoco's Bairoil Project from Phase I and Amoco and Exxon are investigating the terms of a possible CO_2 sale for future enhanced oil recovery projects in Wyoming. Phase I also provides CO_2 for Chevron's CO_2 Project in Rangely, Colorado.

Construction of Phase I of the LaBarge Project is complete and consists of a 480 MMSCFD sour gas processing facility consisting of two 240 MMSCFD modules. Project components for Phase I were constructed in Lincoln, Sublette and Sweetwater counties (see Appendix 4, Map 12). Major Phase I project components consist of the following:

- o 480 MMSCFD sour gas processing facility;
- o Feed gas pipeline from the dehydration facility to the plant;

- o Electrical transmission lines to the plant and the dehydration facility;
- o Railroad spur;
- o Product pipelines;
- o 480 MMSCFD dehydration facility (at the edge of the wellfield);
- o Access roads to the plant site, dehydration facility and wellfield;
- o Sulfur storage and loadout facility;
- o Water supply, control and disposal system;
- o Microwave communication system;
- o Wellfield;
- o Gas gathering pipelines;
- o Wellfield manifold unit.

In February 1985, Exxon requested a permit from the Wyoming Industrial Siting Council to construct Phase II of the LaBarge Project which would increase the maximum processing rate to 1.32 BSCFD (Exxon, 1985). The Phase II expansion would consist of the addition of three processing modules each with an anticipated processing capability of 240 MMSCFD. Initially, Exxon had anticipated the start of construction for Phase II to begin in 1985. Although the Siting Council permitted the expansion, no construction has been initiated to date on Phase II. In addition to expansion of the Shute Creek Plant, Phase II could require the drilling of approximately 20 additional wells in the Riley Ridge Field and construction of an additional 38 mile long trunkline to tie the additional production in the field to the Shute Creek Plant.

The LaBarge Project wellfield extends over a large part of the northern extent of the Moxa Arch located in south Sublette County. Wells are completed in the Madison Formation at an average depth of 16,000 feet. The wellfield is estimated to contain five trillion cubic feet of recoverable low-BTU gas of which approximately one trillion cubic feet would be methane. The gas stream is composed primarily of CO_2 (63.3 percent) and methane (24 percent), with small quantities of ethane, nitrogen and helium. The reservoir also contains a significant quantity of hydrogen sulfide (4.5 percent). The primary objective for Exxon's LaBarge Project is methane recovery (Bryan, 1987). Because the primary purpose of the LaBarge Project is the recovery of methane, it was not designed to capture 100 percent of the CO_2 produced in association with the methane.

Wet gas produced in the field is transported to a dehydration facility in the field where it is dewatered. During September 1987, the average production rate from the field was 480 MMSCFD (Exxon, 1987). From the field dehydration unit, the gas is transported through a 38-mile-long pipeline to the Shute Creek Phase I Plant. The Shute Creek Plant utilizes a two-stage selexol process designed to remove hydrogen sulfide and CO_2 from the gas stream. During September 1987, average production of sulfur was 654 long tons per day (Exxon, 1987).

Selexol can be compared to a magnet in that carbon dioxide is attracted to a Selexol mixture at high pressures. As the pressure is lowered on the Selexol-CO_2 mixture, the CO_2 is released. In September 1987, Exxon sold 178 MMSCFD of CO_2 from the Phase I Shute Creek Plant. In addition to the sales volume, Exxon vented 100 MMSCFD of CO_2 in September (Bryan, 1987). In addition to CO_2, Exxon also sold 101 MMSCFD of methane and 2.7 MMSCFD of helium during September 1987.

All of the CO_2 produced from Phase I of the LaBarge Project is committed to either Chevron (Rangely Unit in Colorado) or Amoco (at Bairoil). In testimony before the Wyoming Oil and Gas Conservation Commission, Exxon stated that if an agreement was reached between Amoco and Exxon to provide CO_2 for the projects evaluated in this DEIS, some type of expansion of the Phase I facilities would be required (Bryan, 1987).

In addition, Exxon recently announced the purchase of the Bell Creek Oil Field in the southeastern Montana portion of the Powder River Basin. Indications are that Exxon is considering implementation of a tertiary recovery program at Bell Creek using CO_2 injection. If CO_2 flooding of Bell Creek occurs in the near future, it appears likely that Exxon would use CO_2 from the LaBarge Project. In fact, the BLM has completed an EIS (BLM, 1986i) for a CO_2 pipeline right-of-way from the Shute Creek Plant to the vicinity of the Bell Creek Field and beyond to the Williston Basin. The right-of-way grant will not be issued until the applicant reapplys and impacts are re-evaluated. Under this scenario, it is likely that not enough CO_2 is available from Phase I of Exxon's LaBarge Project to flood Amoco's fields and Bell Creek.

As an alternative to Amoco's proposed Fontenelle Project, this DEIS includes information regarding the construction of Phase II of Exxon's LaBarge Project. It is impossible at this point to determine what portion of Phase II would actually be constructed under this alternative. Therefore, consistent with the worst-case impact assessment methodology, impacts presented for this alternative describe complete construction of Phase II as analyzed in the Riley Ridge DEIS (BLM, 1983d) and Wyoming Industrial Siting Application for the project (Exxon, 1985).

2.3.2 Alternative Pipeline Alignments

Beaver Creek Alternative. The Beaver Creek Alternative pipeline alignment is shown on Figure 2-6 and on Map 9 in Appendix 4. The alternative alignment (231 miles in total length) would involve the construction of the Beaver Creek Trunk Pipeline (44 miles) and about 55 miles of CO_2 trunk pipeline from the Beaver Creek Plant north to approximately Lost Cabin, Wyoming. From the Lost Cabin area, the alternative alignment would be the same as described for the Elk Basin Trunk Pipeline to the Elk Basin Plant site (approximately 132 miles). This alternative would eliminate the need for Amoco to construct the portion of the Elk Basin Trunk Pipeline between mileposts 132 and 178 (44 miles). The alternative would also eliminate the need to construct the Bairoil/Dakota Pipeline from mileposts 112 to 185 (73 miles) to supply CO_2 for the Elk Basin Project. However, that portion of the Bairoil/Dakota Pipeline would still be necessary to provide the Salt Creek Project with CO_2 under Amoco's Proposed Action.

Frontier/Casper Alternative. This alternative involves the conversion of the existing Frontier Oil Pipeline to CO_2 service. The alternative is shown on Figure 2-7 and on Maps 1 and 8 in Appendix 4. The alternative also involves the construction of 24 miles of pipeline to connect the Fontenelle Plant to the existing Frontier Pipeline. This section of pipeline would be aligned in the existing Exxon Rangely Pipeline corridor. In addition, approximately 40 miles of pipeline would be installed to connect the existing terminus of the Frontier Pipeline to the Salt Creek Field. The Frontier/Casper Alternative would eliminate the need to construct approximately 109 miles of the Bairoil/Dakota Pipeline between milepost 112 and the Salt Creek Field. Selection of this alternative would require Amoco to pursue the Beaver Creek Alternative to supply CO_2 to Elk Basin and Little Buffalo Basin.

2.3.3 No Action Alternative

Implementation of the No Action Alternative would represent denial of necessary rights-of-way for the projects on federal lands.

2.4 IMPLEMENTATION OF PROJECTS

Amoco's Proposed Actions consist of three primary components, including:

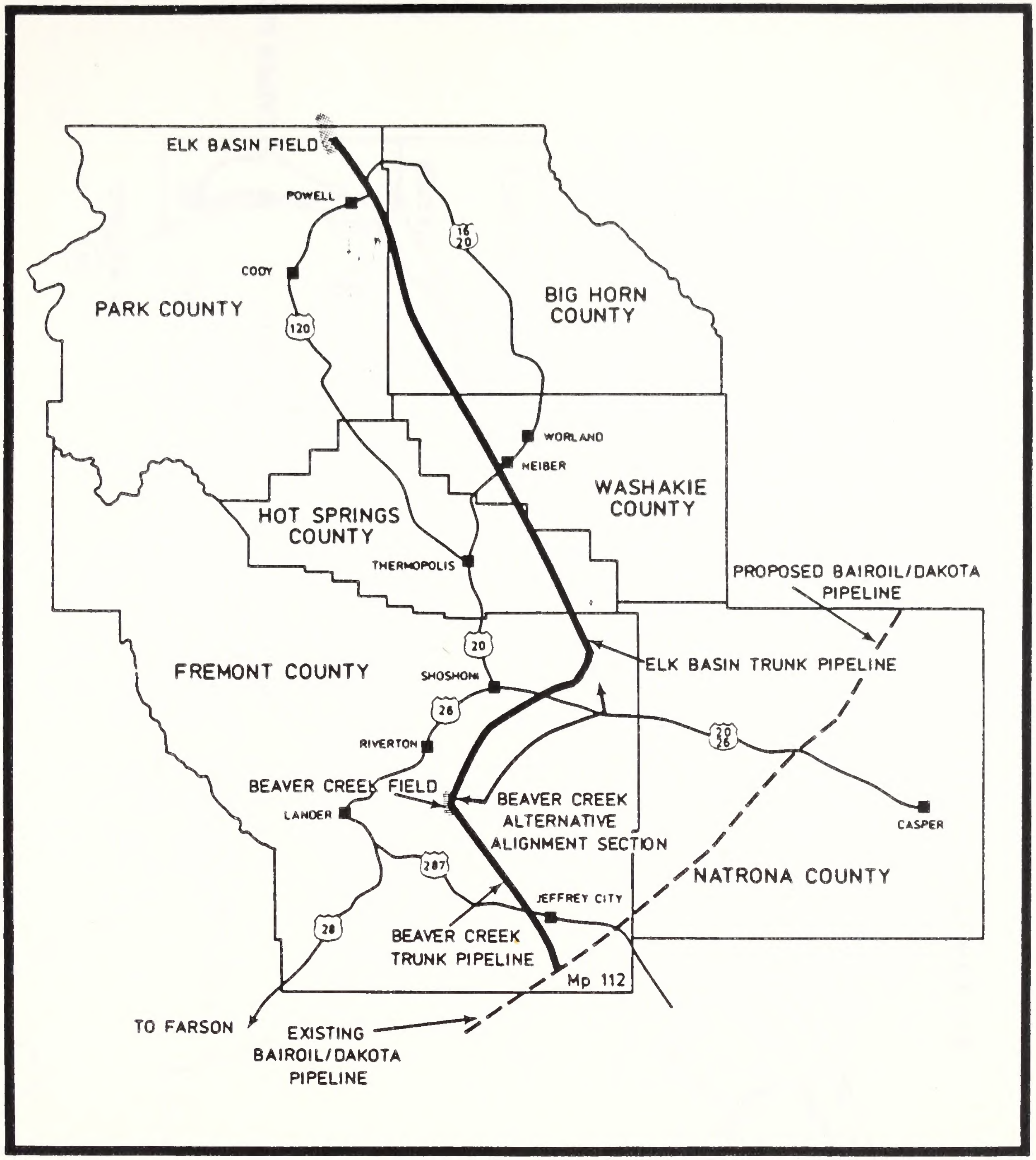


Figure 2—6. Beaver Creek Alternative Including Beaver Creek and Elk Basin Trunk Pipelines and Beaver Creek Alternative Alignment Section.

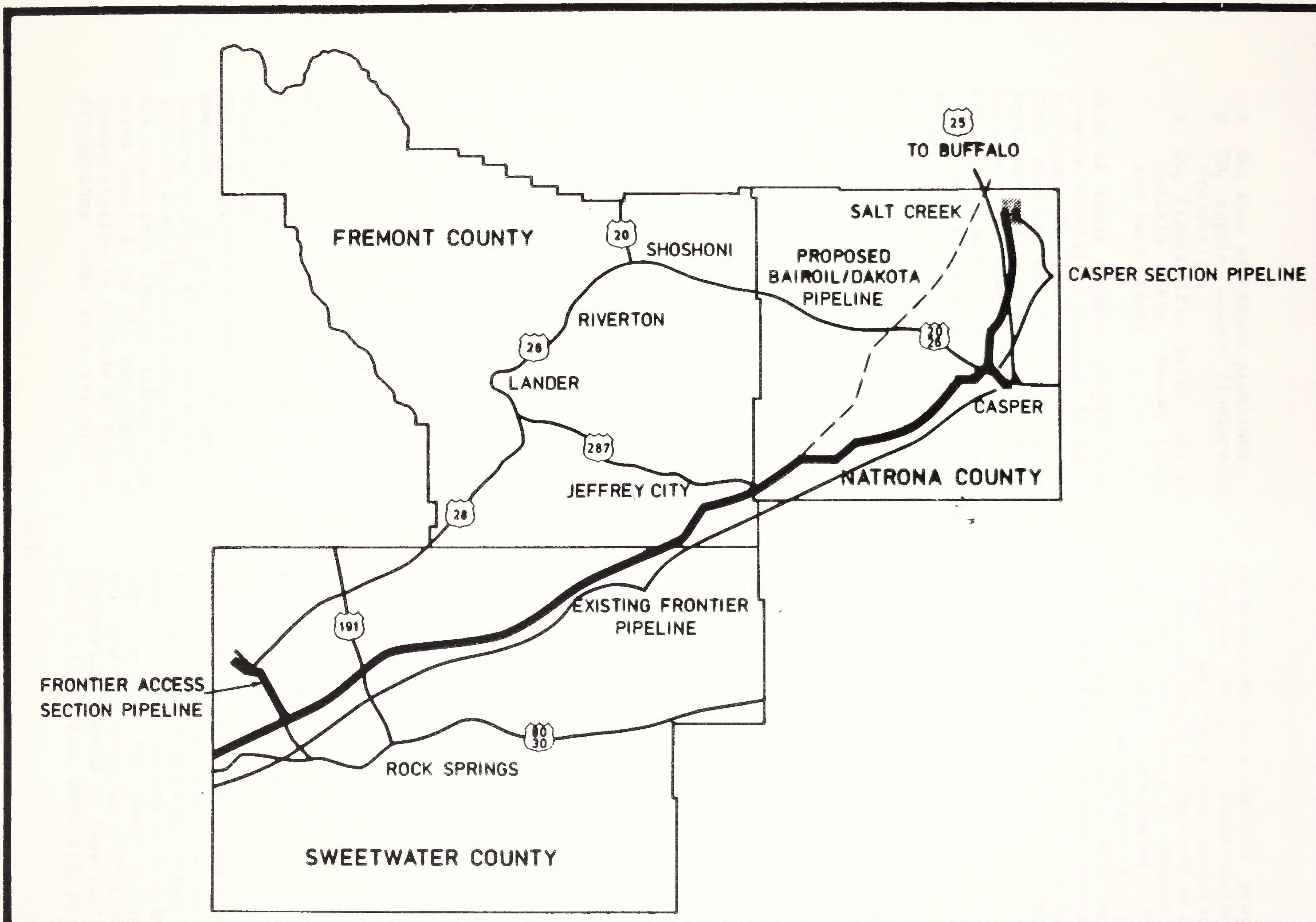


Figure 2—7. Frontier/Casper Alternative Pipeline Including Frontier Access Section, Existing Frontier Pipeline and Casper Section.

- CO_2 spur and trunk pipelines;
- CO_2 supply source (Fontenelle Project);
- CO_2 floods (Elk Basin, Little Buffalo Basin, Beaver Creek and Salt Creek).

Each of these primary project components consist of several types of equipment, facilities and processes. This section describes the major equipment, facilities and processes proposed by Amoco. Development assumptions used during preparation of the DEIS are listed on Table 2-4. Estimated cost projections for major project components are provided on Table 2-5. Completion of all five projects would require expenditures in excess of $500 million.

2.4.1 CO_2 Spur and Trunk Pipelines

Spur and trunk CO_2 pipelines would be required to transport CO_2 from the CO_2 supply source to the fields designated for flooding. CO_2 supply pipelines would range in diameter from 16 to 18 inches (nominal diameter) and would be capable of transporting between 150 and 200 MMSCFD.

The design, material, construction, operation, maintenance and abandonment practices of all project components would be in accordance with safe and proven engineering practices. The spur and trunk pipelines would be designed to operate at a maximum pressure of 2,800 pounds per square inch (*psi*). Actual operating pressure is estimated to be approximately 2,000 psi. The spur and trunk pipelines would operate between 35 and 55°F. The design and construction of the CO_2 pipelines and ancillary facilities would be in accordance with American National Standards Institute (*ANSI*)/ American Society of Mechanical Engineers (*ASME*) B31.8--Gas Transmission and Distribution Piping Systems. All applicable federal safety standards outlined by the Department of Transportation in 49 Code of Federal Regulations (CFR) Part 192 will be incorporated into Amoco's proposed pipeline design. State-of-the-art design, materials and construction techniques would be employed by Amoco and its contractors to ensure that the pipeline will be a low-maintenance system which can operate safely and with minimal risk to the environment. The *ANSI/ASME* B31.8 code covers the design, fabrication, installation, inspection, testing and safety aspects of construction, operation and maintenance of gas transmission and distribution systems, including gas pipelines, gas compressor stations, gas metering and regulation stations, gas mains and service lines. The requirements of ANSI/ASME B31.8 also include the conditions of use of elements of the piping system including pipe, valves, fittings and flanges, gaskets, regulators, pressure vessels, pulsation dampeners and relief valves.

The ANSI/ASME B31.8 code is principally concerned with safety of the general public and employees to the extent that safety is affected by basic design, quality of materials and workmanship and requirements for testing, operations and maintenance of gas transmission and distribution facilities.

Both ANSI/ASME B31.8 and the Department of Transportation have developed design standards for pipelines which take into account the population density in areas adjacent to the pipelines. Based upon population density in areas adjacent to the pipeline, a class location is designated. These class locations are used to establish design criteria for the pipeline system. A class location unit is an area that extends 220 yards on either side of the centerline for any continuous one-mile length of pipeline. The class location is determined by the number and types of buildings in the class location unit. A Class 1 location is any class location unit that has ten or less buildings intended for human occupancy. All spur and trunk CO_2 pipelines and alternatives would be constructed in Class 1 locations. According to ANSI/

Table 2-4. Development Assumptions Utilized During the Preparation of the Draft Environmental Impact Statement.

Project	CO_2 Pipeline Diameter (Nominal Diameter)	Pipe Design Throughput (MMSCFD)	Plant Capacity (MMSCFD)	Total CO_2 Requirements (Including Purchased CO_2) (BCF)	Total Purchased CO_2 (BCF)	EOR Method
Fontenelle Project	N/A	N/A	150	N/A	N/A	N/A
Elk Basin Project	18	200	150	326	234	Miscible CO_2
Beaver Creek Project	18	200	150	165	72	Miscible CO_2
Little Buffalo Basin Project	16	150	150	250	100	Immiscible CO_2
Salt Creek Project	18	150	150	394	109	Immiscible CO_2

MMSCFD = million standard cubic feet per day
BCF = billion cubic feet
MMBO = million barrels of oil

Table 2-5. Estimated Construction Expenditures (in 1987 $) for Major Project Components of the Proposed Actions.

Project	Plant Expenditures (million $)			Field Expenditures (million $)			Pipeline Expenditures (million $) (a)			Total Project Expenditures (million $)
	Material	Labor	Total	Material	Labor	Total	Material	Labor	Total	
Fontenelle	24.8	35.2	60	7.3	2.7	10(b)	.34	.66	1(c)	71
Elk Basin	24.8	35.2	60	21.8	8.2	30	22.2	43.8	66(d)	156
Little Buffalo Basin	10.4	14.6	25	14.5	5.5	20	3.4	6.6	10	55
Beaver Creek	10.4	14.6	25	14.5	5.5	20	6.1	11.9	18	63
Salt Creek	10.4	14.6	25	101.6	38.4	140	1	2	3	168

a = Includes trunk and spur pipeline costs.
b = Excludes cost of drilling wells (approximately $10 million).
c = Pipe cost to tie Fontenelle Plant to Exxon Carbon Dioxide Pipeline.
d = Excludes installation cost of approved Exxon pipeline from MP 112 to the Salt Creek Field; includes cost of trunk pipeline from Natron, Wyoming, to the Elk Basin Field.

ASME B31.8, a Class 1 location is intended to reflect "...deserts, mountains, grazing land, farmland and sparsely populated areas."

In addition to the class location, ANSI/ASME B31.8 was used to determine the appropriate construction type for spur and trunk pipelines. This classification system determined the design factor used in a particular location within the class location such as road and pipeline crossings.

The design factor recommended by ANSI/ASME B31.8 for Class 1 locations is 0.72 (72 percent of specified minimum yield strength of the pipe). The design factor recommended by ANSI/ASME B31.8 for mainline valve assemblies, uncased public road crossings, above-ground piping and *scraper traps* is 0.6 (60 percent of minimum yield strength of the pipe). Specified minimum yield strength is the minimum yield strength prescribed by the specification under which the pipe is purchased from the manufacturer. Yield strength is the strength at which a material exhibits a specified minimum limiting permanent set or produces a specified total elongation under a load.

Pipe. All materials used in the construction of spur and trunk pipelines and field piping would meet or exceed ANSI/ASME B31.8 specifications. Pipe materials would conform to the requirements of the American Petroleum Institute (*API*) 5LX - 60, "Specifications for Line Pipe," or equal or more stringent Amoco specifications. Individual sections of pipe would range between 55 and 60 linear feet. Pipe installed under rivers would be coated with at least a 1-inch concrete jacket to ensure that the pipe remains in its trench until covered.

Prior to installation, the pipe would be coated for protection in accordance with National Association of Pipe Coating Applicators (*NAPC*) specifications or equal or more stringent Amoco specifications. The pipe would be delivered to the construction site with either a 1) 14 to 16 mil thick fusion bonded epoxy coating or 2) a 10 mil mastic and 40 mil polyethylene coating. The construction contractor would apply coating to each field joint after welding has been completed and the weld accepted by an inspector. Field joint coating may consist of cold applied tape, shrink sleeves or fusion-bonded epoxy.

Block Valves. Valves would be installed to block the flow of CO_2. Valves would be installed at the origin and meter stations of the pipelines and, pursuant to ANSI/ASME B31.8, at spacing intervals generally not exceeding 20 miles. In addition, automated block valves (designed to handle sour gas) would be placed on both sides of the Fontenelle Gas Gathering System crossing of the Green River in Section 16, T.23 N., R.111 W. Block valve stations would occupy about 0.1 acre. When selecting precise locations for block valves, primary consideration would be given to locations which provide year-round accessibility to the valves.

Exact locations of valves for pipelines have not been determined at this time. Guard rails or chain link fencing would be installed at all valves located along the pipelines (see Figure 2-8). Each valve would meet the minimum requirements or the equivalent of API 6A, API 6D, Manufacturer's Standardization Society (*MSS*) SP-70, MSS SP-71 or MSS SP-78. Valves would meet all maximum operating conditions and would contain no ductile iron in the body or the components. Internals (seals, slab, stem and elastometers) would meet the material requirements of the National Association of Corrosion Engineers (*NACE*) MR-01-75. Elastometers would also meet requirements for CO_2 service. Mainline and scraper trap valves would be weld-end. Inlet and bypass valves would be set on concrete foundations. Scraper trap blowdown and drain valves would meet the design criteria of ANSI 1500 *RJT* flanged ends but would be mounted above ground level. Although most block valves

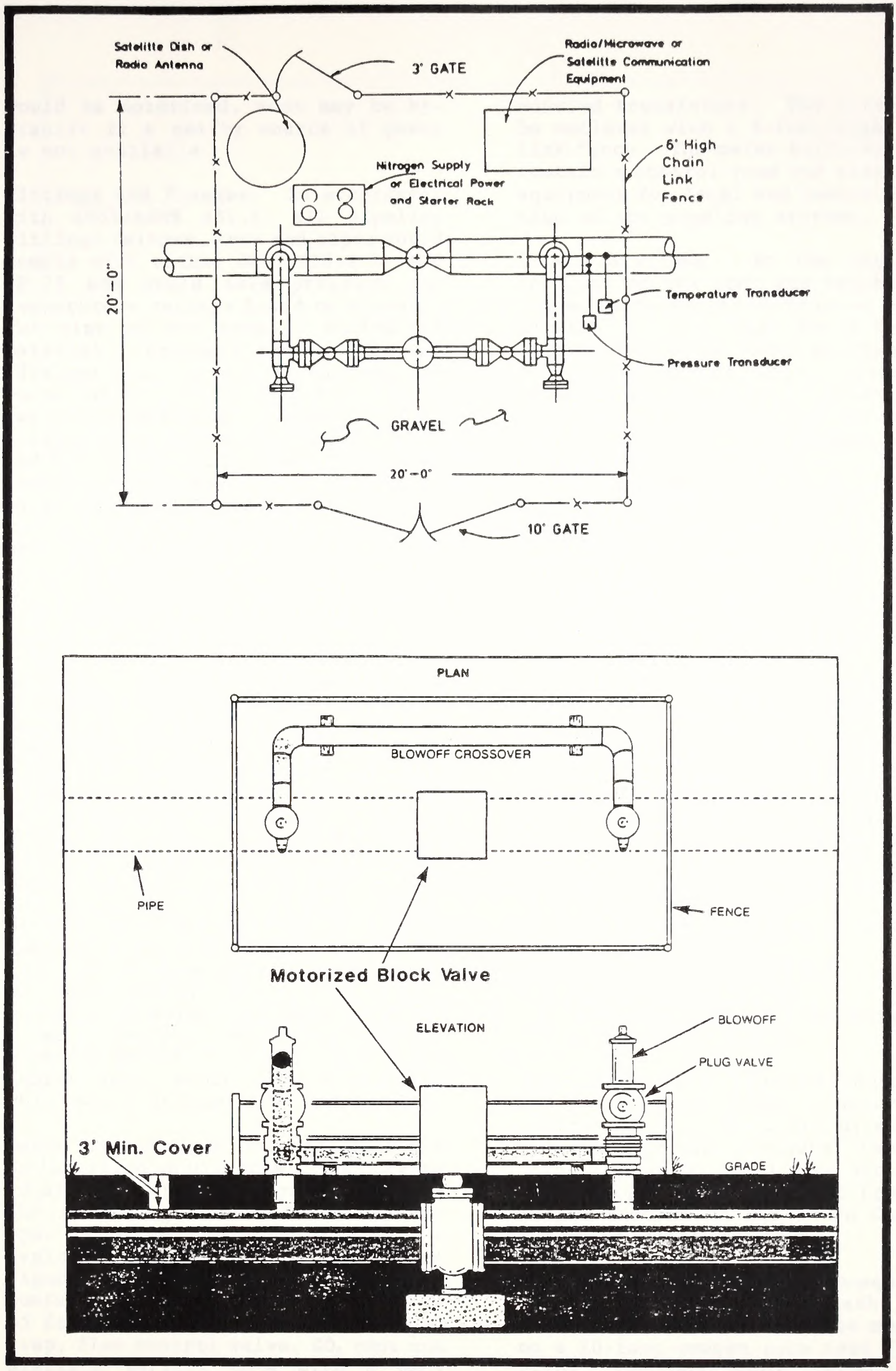


Figure 2—8. Plot Plan and Profile of Typical Block Valve Assembly.

would be motorized, some may be hydraulic if a nearby source of power is not available.

Fittings and Flanges. In accordance with ANSI/ASME B31.8, all pipeline fittings (elbows, tees and caps) would comply with either ANSI B16.9 or MSS SP-75 and would have pressure and temperature ratings based on stresses for pipe of the same or equivalent material. Pressure ratings for the fittings would be calculated using the rules established by ANSI B31, "Codes for Pressure Piping." Dimensions and tolerances would conform to ANSI B16.9 and MSS SP-75. Flanges would meet the requirements of ANSI B16.5 and MSS SP-44 as required by ANSI B31.8. Fittings would be marked in accordance with the applicable code to preclude installation errors. Bevel design would conform to the appropriate code and welding procedures would incorporate the bevel design.

Markers. After construction is complete, pipeline markers would be installed to identify the pipeline centerline. Milepost markers would be placed at approximately one-mile intervals in open country. In cultivated areas, the markers would be placed on fence rows, right-of-way lines of roads and highways, or at other protected areas as near to one-mile intervals as practical. Aerial markers would be installed at approximately five-mile intervals. The location of each pipe crossing would be conspicuously identified by a line marker installed on each side of river, highway and railroad crossings. Pipeline markers would provide a phone number which would ring a location which would be manned 24 hours daily.

Meter Stations. Meter stations would be installed on 0.2-acre sites located adjacent to the CO_2 recycle plants at the terminus of each CO_2 trunk and spur pipeline. A plot plan for a typical meter station is shown on Figure 2-9. The meter stations would contain a meter building approximately 35 feet x 75 feet, receiving scraper trap, flow control valve, CO_2 vent and electric service pole with a pad-mounted transformer. The site would be enclosed with a 6-foot-high chain link fence. The meter building would contain a control room and associated equipment for local and remote operation of the pipeline systems.

Origin Stations. At the beginning (origin) of the spur and trunk pipelines, Amoco would construct an origin station. A plot plan for a typical origin station is shown on Figure 2-10. The station would contain a scraper launcher, radio transmitting unit (*RTU*) and a gas chromatograph which would be used to measure the molecular mixture of the CO_2. The RTU would be housed in a 12-foot x 12-foot building located adjacent to the connection. The RTU would monitor pipeline pressure, temperature and other relevant factors. The origin station would be enclosed within a 6-foot-high chain link fence. Each origin station would occupy 0.1 acres.

Communication System. The spur and trunk CO_2 pipeline communication systems would utilize an existing Amoco satellite and microwave communications system. Satellite dishes would be installed at the existing Amoco microwave repeater stations and at the origin and meter stations for each CO_2 pipeline. The systems would provide the following services:

- o Fixed-station voice communication;
- o Mobile communication;
- o Data communication;
- o Digital data transmission for the SCADA system.

The communication system would utilize an established SCADA (supervisory control and data acquisition) system. Data on pipeline pressure, temperature, flow rate, total flow and alarm status would be transmitted from the origin station to the Amoco Control Center in Tulsa, Oklahoma.

Amoco would install a radio-equipped remote terminal unit at each block valve. The antenna would be mounted on a 20-foot wooden pole (see Figure 2-10). The radio would transmit data

would be motorized, some may be hydraulic if a nearby source of power is not available.

Fittings and Flanges. In accordance with ANSI/ASME B31.8 all piping fittings (elbows, tees and caps) would comply with either [illegible] and would have pressure [illegible] temperature ratings based on stresses for pipe of the same or equivalent material. [illegible] fittings would be [illegible] [illegible]

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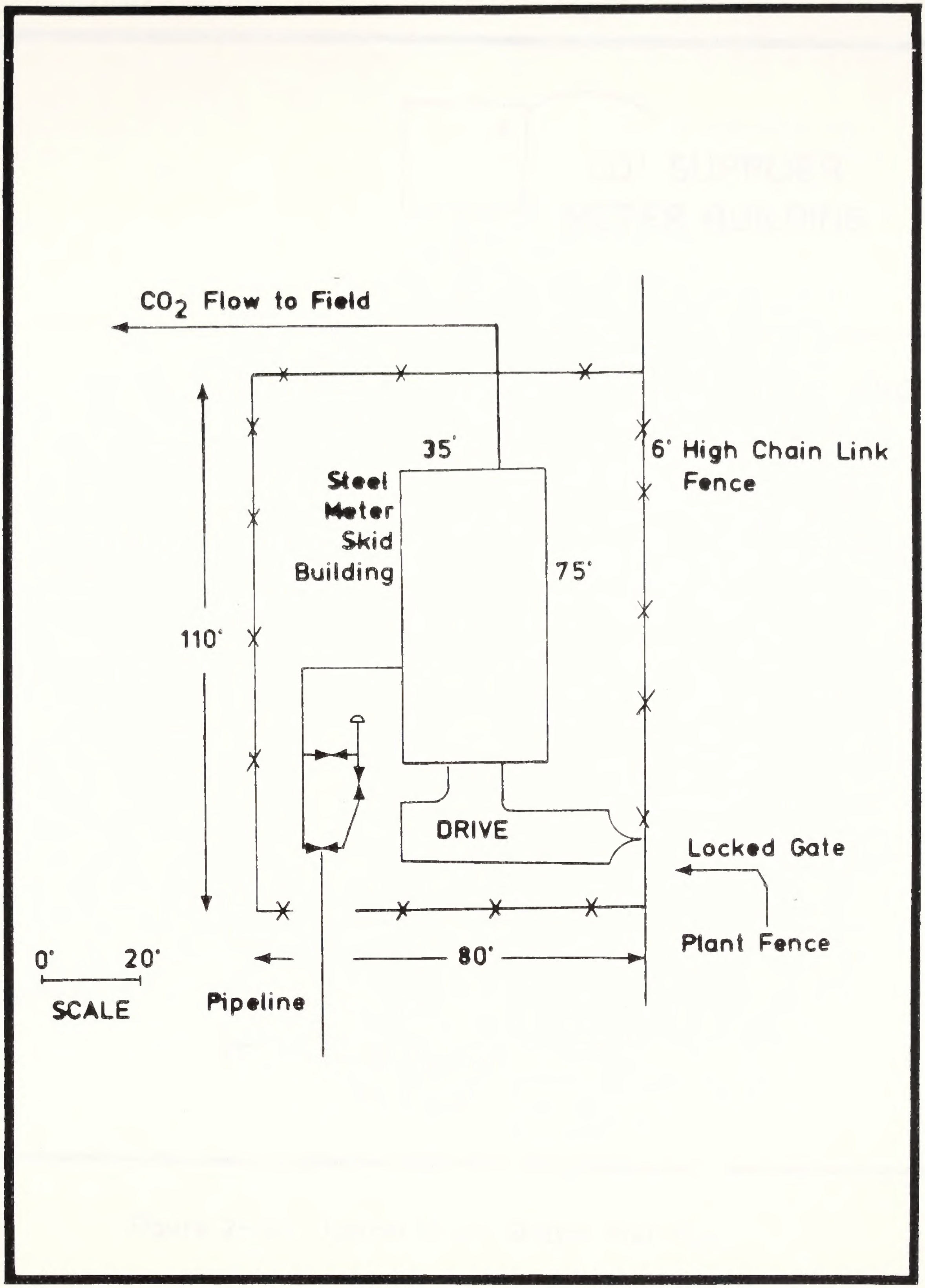

Figure 2—9. Typical Meter Station Plot Plan.

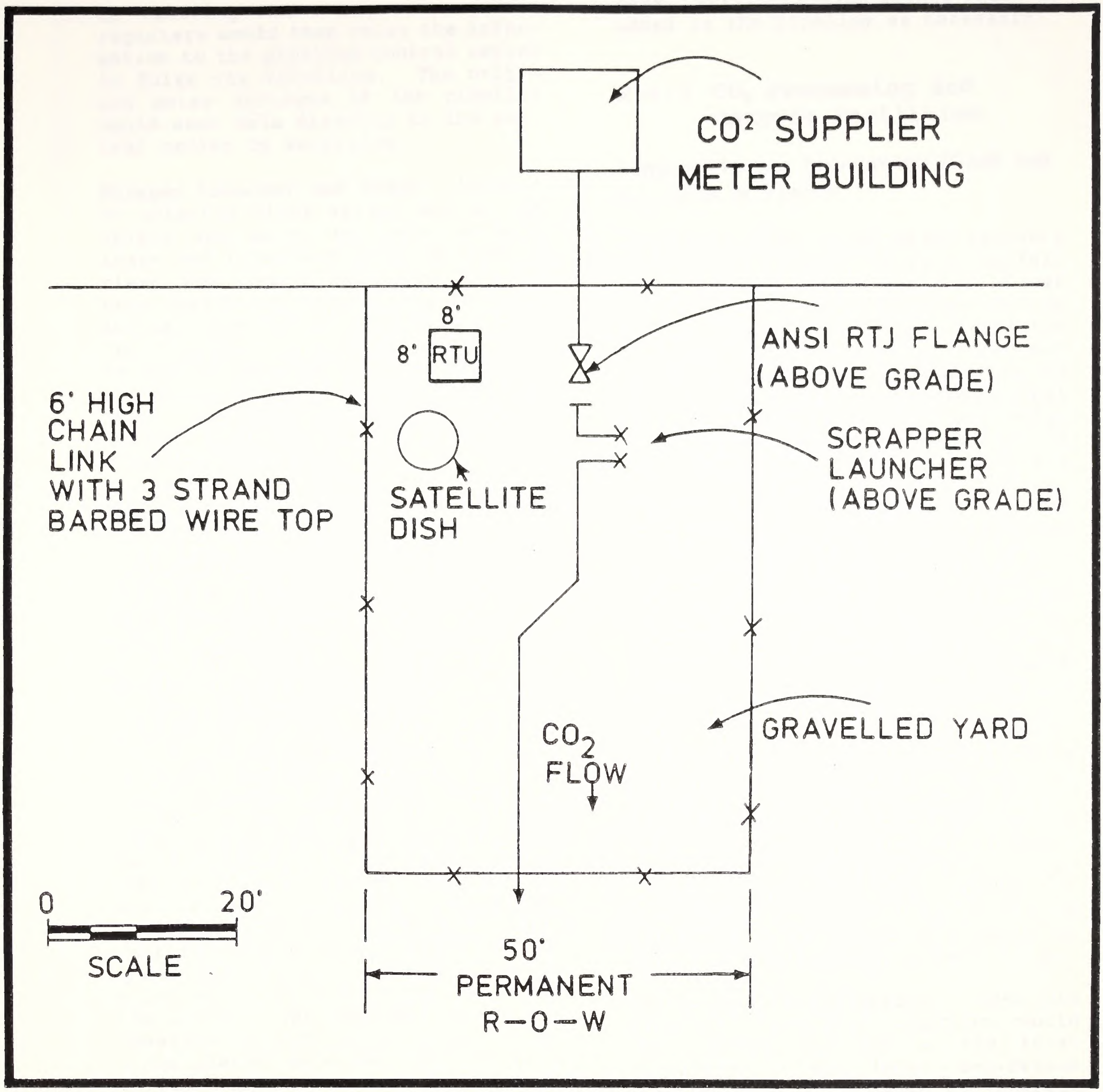

Figure 2—10. Typical Origin Station Plot Plan.

to existing Amoco repeaters. The repeaters would then relay the information to the pipeline control center in Tulsa via satellite. The origin and meter stations of the pipeline would send data directly to the control center by satellite.

Scraper Launcher and Traps. Located at selected block valves and at the origin and meter stations, scraper traps and launchers would be used to clean and remove condensed liquids from inside the pipe during start-up and maintenance. During maintenance, the internal scraper (or pig) would be placed into the scraper launcher, and forced by gas pressure through the pipe. The pig would be caught at the scraper trap and removed along with collected debris.

Corrosion Protection System. Protecting the spur and trunk pipelines from corrosion is key to reducing the environmental risks of operating the pipelines. Protecting the pipelines from corrosion involves two important design factors: 1) the installation of a pipe coating to protect the pipelines from contacting the soil and 2) the installation of a cathodic protection system. The cathodic protection system would be designed to remove impressed current that may build up on the pipeline. Impressed current on the pipeline is a primary cause of increased rates of corrosion. The cathodic protection system would consist of a rectifier, junction box and deep well anode bed. The system is illustrated on Figure 2-11. The rectifier would be mounted on a concrete pad adjacent to existing power poles which provide electricity for the system. The deep well anode bed consists of the installation of an anode placed in a well drilled at a location approximately 300 to 500 feet from the pipeline. Precise locations of cathodic protection rectifier sites would be determined after tests are conducted on the operating pipeline system.

Internal pipeline corrosion would be monitored through the use of corrosion tabs. Anti-corrosion agents would be added to the pipeline as necessary.

2.4.2 CO_2 Processing and Recycle Facilities

Fontenelle Gas Processing Plant and CO_2 Recycle Plants

Implementing CO_2-enhanced oil recovery in the Elk Basin, Little Buffalo Basin, Beaver Creek and Salt Creek fields would require the construction of CO_2 recycle plants and associated wellfield-related facilities and equipment. This section describes the various processes and equipment that may be incorporated into the design of the various projects. Not all of the projects would include all of the equipment discussed in this section. Table 2-6 lists the various types of processes and equipment incorporated in the design of CO_2 recycle plants and the Fontenelle Gas Processing Plant. A simplified process flow diagram for a CO_2 recycle plant containing all the processes described in this section is provided on Figure 2-12. A process flow diagram for the Fontenelle Plant is shown on Figure 2-13. Figure 2-14 provides a schematic diagram of how the CO_2 flooding process would function. As many as seven major processes would be incorporated into the four CO_2 recycle plants and the Fontenelle Gas Processing Plant. The processes are discussed below and the reader is encouraged to refer to Table 2-6 to determine which components would be incorporated into each project design.

Inlet Separation System. Feed gas from all producing formations would be combined and fed to the inlet separator. The inlet separation system would be designed to separate oil and produced water from the inlet gas stream. Although the primary point of oil, water and gas separation would remain the field production facilities, additional liquids will condense in the gathering system downstream of the field production facilities as the gas cools. From

tabs [illegible]
added to [illegible] pipeline [illegible]

2.4.[illegible] [illegible]

[illegible]

to existing Amoco repeaters. The repeaters would then relay the information to the pipeline control center in Tulsa via satellite. The origin and meter stations of the pipeline would send data directly to the control center by satellite.

Scraper Launches and Traps. [illegible] valves and at the [illegible] stations, scraper traps and launchers would be used to clean and remove condensed liquids from the pipe during start-up and maintenance. [illegible] the internal [illegible] be placed [illegible] the scraper launchers and [illegible] the [illegible] scraper [illegible] recovered along with collected debris.

Corrosion Prevention Systems. [illegible] the [illegible] pipeline [illegible] [illegible]

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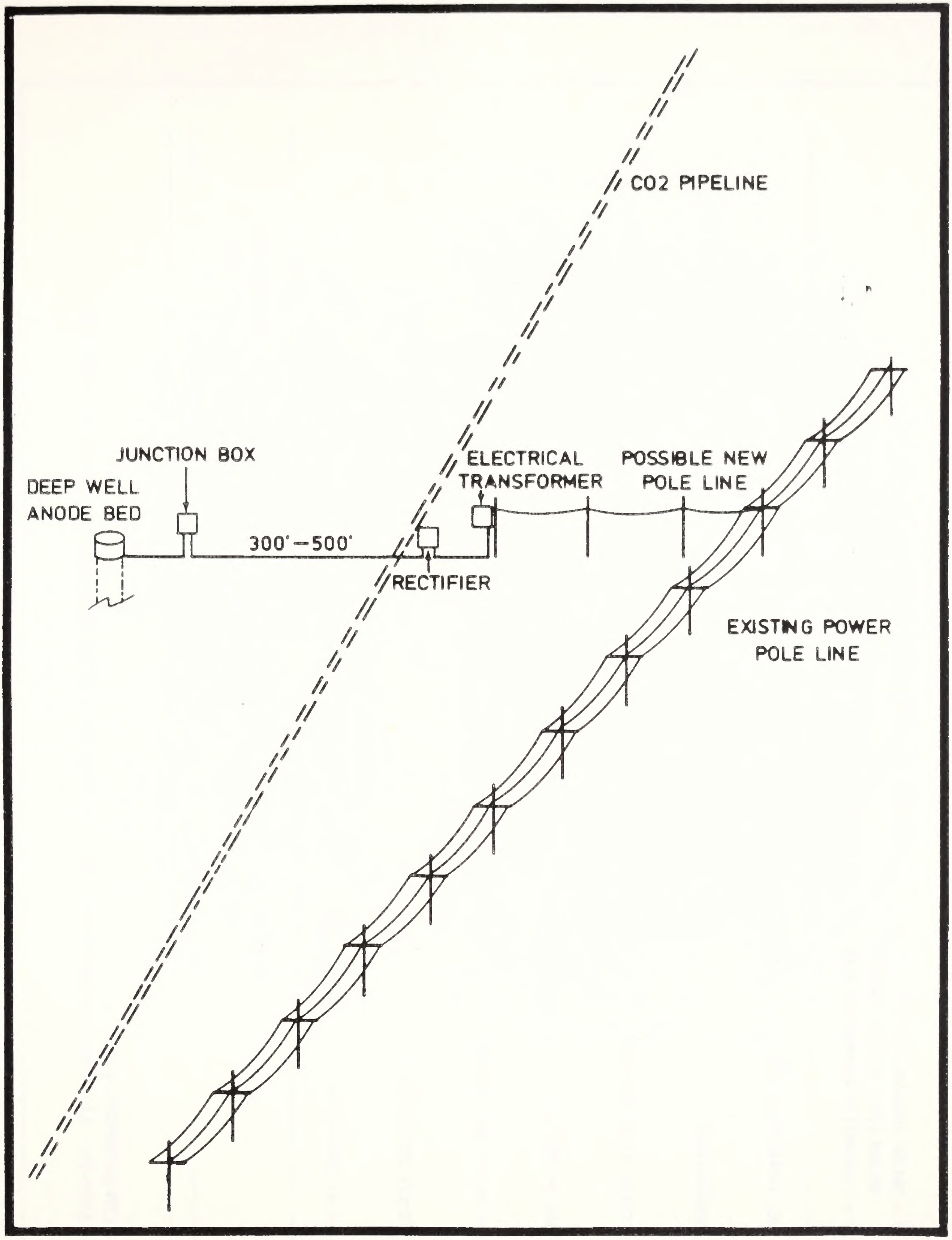


Figure 2—11. Plan View of Pipeline Cathodic Protection System.

Table 2-6. Proposed Processes Incorporated into the Design of the Carbon Dioxide Recycle Plants and the Gas Processing Plant.

	Fontenelle Gas Processing Plant	Elk Basin Recycle Plant	Little Buffalo Basin Recycle Plant	Beaver Creek Recycle Plant	Salt Creek Recycle Plant
Inlet Separation	Yes	Yes	Yes	Yes	Yes
LO-CAT Sweetening (a)	No	Yes	Yes	Yes	Yes
Selective H2S Removal	Yes	No	No	No	No
TEG Dehydration	Yes	Yes	Yes	Yes	Yes
CO2/NGL Fractionation	No	Yes	Yes	Yes	Yes
Demethanizer	No	Yes	No	Yes	No
NGL Treating/Storage	No	No (b)	Yes	No (b)	Yes

a = Alternative sweetening, with at least the same recovery efficiency as LO-CAT, may be chosen during final project design.
b = Design incorporates existing NGL treating and/or storage presently available in the fields.

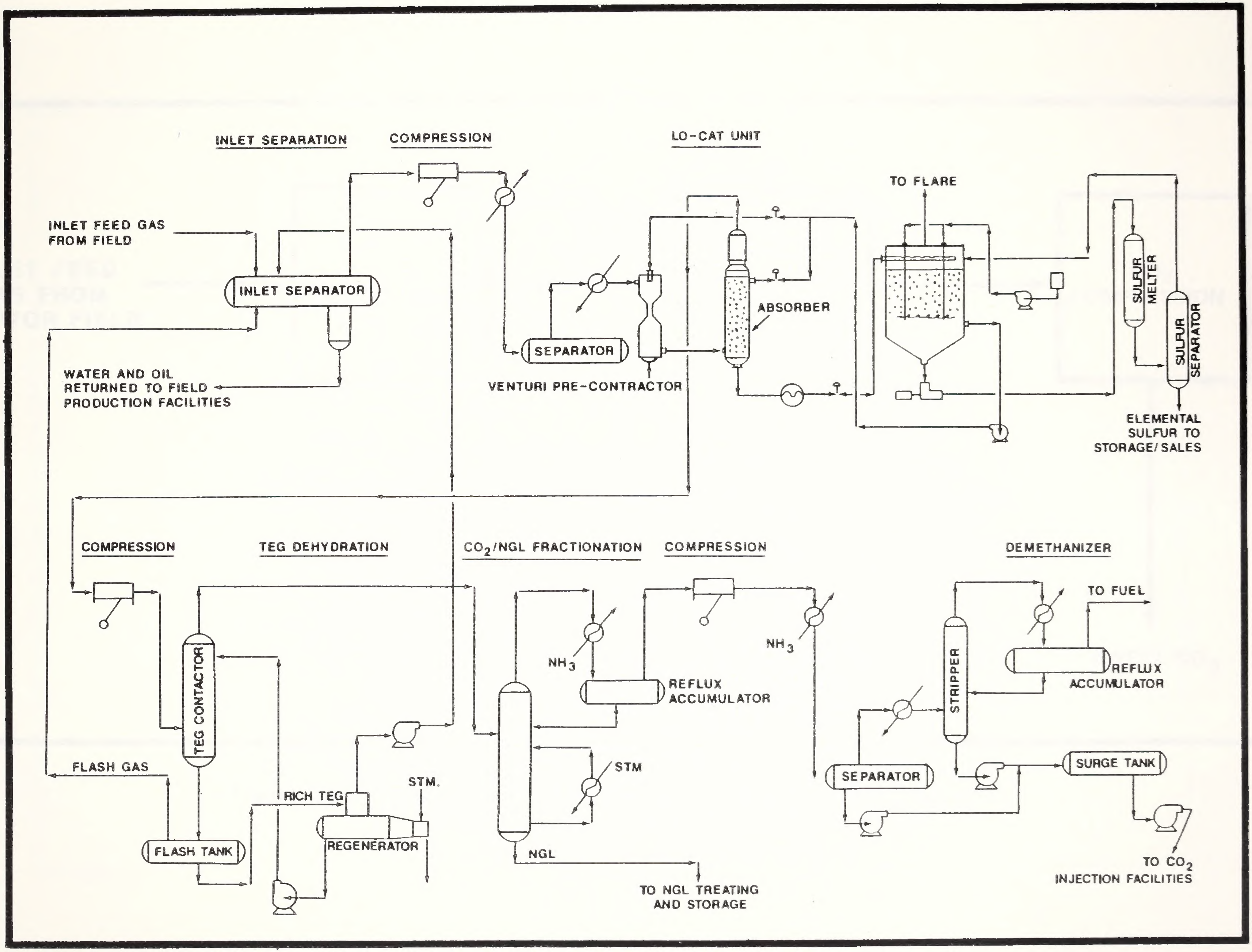


Figure 2—12. Recycle Plant Process Flow Diagram.

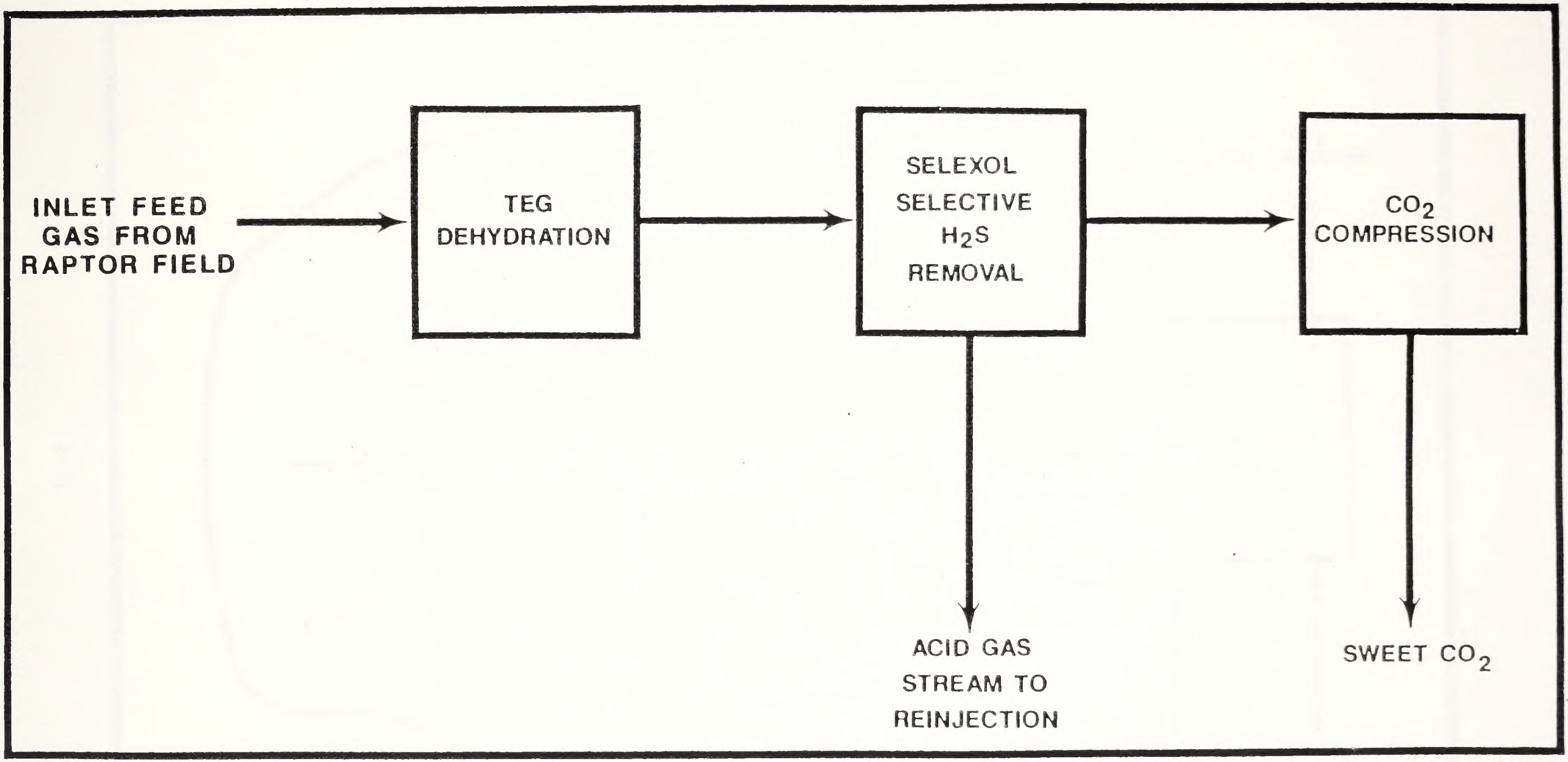


Figure 2—13. Fontenelle Gas Processing Plant Process Flow Diagram.

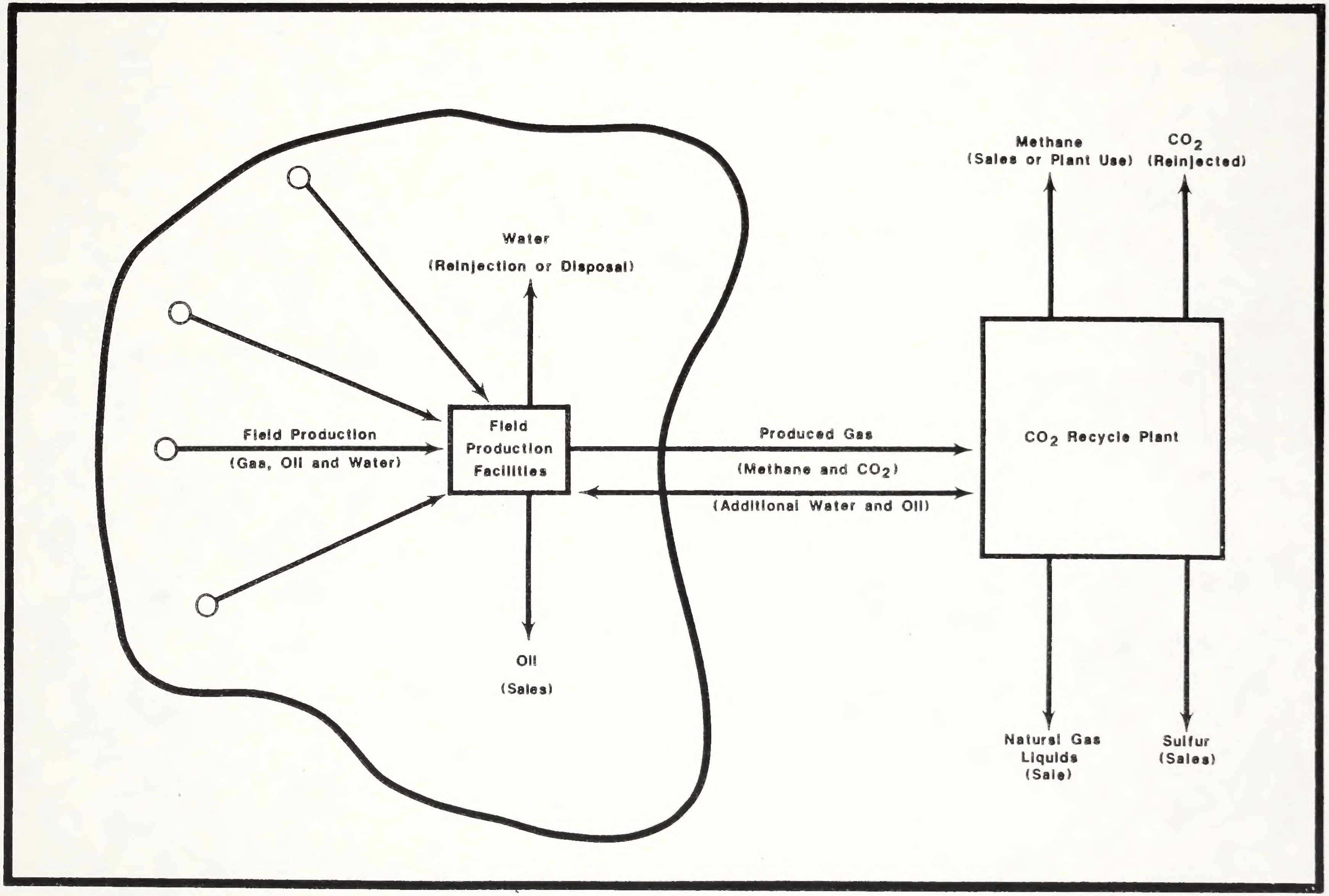


Figure 2—14. Diagram of CO_2 Flow Through Plant and Field.

the inlet separation system, gas would be fed to the LO-CAT H_2S oxidation system. Oil and produced water removed from the gas stream in the inlet separation system would be piped back to the field production facilities for sales and reinjection, respectively. Excess water would be reinjected through a series of existing underground injection control (*UIC*) wells or treated and surface discharged at existing National Pollution Discharge Elimination System (*NPDES*) discharge points in the fields. Injection or surface discharge would be conducted in accordance with applicable state and federal regulations. Gas leaving the inlet separator would be fed to an inlet filter/separator and an inlet gas/gas exchanger prior to being fed to the LO-CAT Unit.

LO-CAT Gas Sweetening System. The LO-CAT unit is a proprietary system licensed and designed by ARI Technologies, Inc. and would be the only source of sulfur *emissions* from the CO_2 recycle plants during routine operations. Other sulfur recovery processes, with equal efficiency, may be substituted for the LO-CAT during final project design. The LO-CAT unit scrubs H_2S out of the gas stream and converts it directly to elemental sulfur. The scrubbing medium used in the LO-CAT process is a diluted water solution of iron, held in solution with an organic chelating agent and buffered with soda ash, potassium hydroxide or any other common alkali. When the H_2S is contacted with the reagent in the absorber, it reacts with the dissolved iron to form solid elemental sulfur.

A solid sulfur and water slurry would be circulated from the solution settler to a sulfur melter and separator. Molten sulfur would be routed to storage and would be trucked out in liquid form. No markets for the sulfur by-product have been identified at this time. Water vaporized in the sulfur melter would be returned to the oxidizer where it condenses back into the circulating system. "Sweetened" gas would be fed from the absorber through compression to the dehydration system. The oxidation reaction is completely specific to H_2S and small amounts of hydrocarbons and CO_2 may be transferred to the oxidizer by virtue of solubility in the aqueous solution.

The LO-CAT process uses proprietary catalytic chelating agents (ARI-310 and ARI-310M). The chelating agents are a mixture of ethylenediamine tera acetic acid (EDTA) and polyhydroxylated sugar. The chelating agents would be used to prevent the formation and precipitation of insoluble iron in the solution. No toxic or hazardous chemicals would be used or produced in the LO-CAT unit. According to the manufacturer, the LO-CAT unit is capable of removing 99.9 percent or more of the H_2S from the gas stream.

The only continuous source of sulfur emissions from the CO_2 recycle plants would be off-gas from the LO-CAT units. Only very small amounts of H_2S would be emitted from the LO-CAT unit. An analysis of gas composition from the LO-CAT at the Bairoil Plant is included in Table 2-7. The results of that analysis are consistent with the manufacturer's efficiency rating for the equipment. Gas from the LO-CAT would be routed to a flare and burned. Total emissions from the LO-CATs at the four CO_2 recycle plants are expected to total less than 200 pounds per year of H_2S in concentrations in the 5 to 6 *ppm* range.

Selexol Selective H_2S Removal. The Fontenelle Gas Processing Plant design would replace the LO-CAT unit with a Selexol process. Selexol would allow the selective removal of H_2S from the gas stream creating a sweet CO_2 stream and an acid gas stream. The acid gas stream would consist primarily of H_2S. Amoco proposes to dispose of this acid gas through reinjection back into the Madison Formation, thereby eliminating all sulfur emissions from the plant.

TEG Dehydration System. The triethylene glycol (*TEG*) dehydration system would reduce water content in sweet-

Table 2-7. Gas Chromatographic Analysis of LO-CAT Off-Gas from the Bairoil CO2 Recycle Plant.

Component	Sample # 1	Sample # 2	Sample # 3
Nitrogen	55.03 mole %	54.96 mole %	55.04 mole %
Methane	N/D	N/D	N/D
Hydrogen Sulfide	5.0 ppm	6.2 ppm	5.5 ppm
Carbonyl Sulfide	N/D	N/D	N/D
Carbon Disulfide	N/D	N/D	N/D
Sulfur Dioxide	N/D	N/D	N/D
Methyl Mercaptan	N/D	N/D	N/D
Ethyl Mercaptan	N/D	N/D	N/D
Propyl Mercaptan	N/D	N/D	N/D
Butyl Mercaptan	N/D	N/D	N/D
Total Mercaptan	N/D	N/D	N/D
Carbon Dioxide	44.97 mole %	45.04 mole %	44.96 mole %
Ethane	0.00	0.00	0.00
Propane	57 ppm	49 ppm	48 ppm
i-Butane	14 ppm	16 ppm	16 ppm
n-Butane	22 ppm	22 ppm	24 ppm
i-Pentane	<5 ppm	<5 ppm	<5 ppm
n-Pentane	<5 ppm	<5 ppm	<5 ppm
Hexanes Plus	N/D	N/D	N/D
Calc. Specific Gravity	1.2152	1.2156	1.2152
Calc BTU	0	0	0
Temperature	135 F	135 F	135 F

N/D = Not detected

ened gas from the LO-CAT. Feed gas from the LO-CAT would enter the glycol contactor and flow upwards counter-current to the high concentration glycol introduced at the top section of the tower. The percentage of water removed by glycol would be dependent upon the level of water which can be tolerated in the dehydrated stream without condensing water, freezing or hydrate formation in the fractionation system and CO_2 injection system.

The wet glycol would be removed from the bottom of the contactor and pre-heated in a glycol reflux condenser. The wet glycol would then circulate to a flash tank where the hydrocarbons absorbed in the glycol would be flashed out and recirculated back to the inlet separation system. Rich glycol from the flash tank would circulate through a hay filter, sock filter, lean/rich glycol exchanger and into a reboiler still column and regenerator where the water would be removed by a distillation process. Lean glycol would leave the regenerator and flow to a TEG surge drum. The TEG would be pumped from the vessel through a TEG cooler, TEG charcoal filter and a lean TEG sock filter before entering the top of the TEG contactor. Dry gas from the top of the contactor would be circulated to the CO_2/NGL (natural gas liquids) fractionation system.

CO_2/NGL Fractionation System. The inlet gas stream, having passed through the LO-CAT, compression and dehydration stages of the CO_2 recycle plant process, would be circulated to the CO_2/NGL fractionation tower. The gas from the top of the tower would be chilled, condensing some heavier hydrocarbons (NGLs) into liquid which would be refluxed back to the top of the tower. This NGL would travel down through the tower, contacting the upward moving gas, collecting more of the heavier hydrocarbons. The NGL in the bottom of the tower would be heated to drive off any remaining methane, nitrogen and CO_2. The NGL would then be cooled and circulated to NGL treating and storage.

The gas that is not condensed would consist primarily of natural gas (methane and ethane), nitrogen and CO_2. This stream would be compressed and circulated to the demethanizer system.

Demethanizer System. The gas from the overhead CO_2/NGL fractionator would be cooled and circulated to the methane stripper tower. The gas from the top of this tower would be chilled using an ammonia refrigeration system, condensing out liquid which consists primarily of CO_2. The liquified CO_2 would travel down through the tower allowing further removal of more CO_2 from the gas stream. The liquid CO_2 leaving the bottom of the tower would be pumped to the CO_2 distribution system for reinjection. The gas that is not condensed in the ammonia refrigeration system would consist primarily of methane, ethane, nitrogen and CO_2. This stream would be sold or heated and used to fuel the plants.

NGL Treating and Storage. The NGL stream from the bottom of the CO_2/NGL fractionator would be mixed with a caustic solution to absorb any CO_2. The NGL/caustic stream would then be pumped to the caustic separator where the caustic is settled out from the NGL due to the specific gravity difference and essential *immiscibility*. The NGL would then be circulated through a sand filter and the NGL pumped to NGL storage tanks. From the tanks, the NGL would be pumped through a meter skid and sold. NGL would either be mixed with oil for sales or trucked from the plant sites.

2.4.3 Field Facilities and Equipment

Development of the Raptor Field to supply CO_2 for the proposed floods would require drilling of ten producing wells. About three miles of road construction and wellfield production flowlines would be required to serve each well site.

Implementation of CO_2 floods in the Elk Basin, Beaver Creek, Little Buffalo Basin and Salt Creek fields may result in the replacement of existing flow and injection systems. These systems were installed to waterflood the fields and may not be capable of injecting or producing a more corrosive and higher pressure CO_2 stream. Table 2-8 lists the miles of flowlines and injection lines in each of the fields. Also included on the table are the number of producing and injection wells in each field.

A worst case assessment of wellfield related impacts would be based on the assumption that all existing flow and injection pipelines would be replaced. However, all disturbances would occur in existing fields. The Bureau of Land Management will analyze the impacts associated with these and other wellfield-related activities through supplemental environmental analysis following the screening process as outlined in the 1791 BLM Manual.

CO_2 Injection System. This system is designed to deliver CO_2 from both the spur and trunk pipelines and the CO_2 recycle plants to individual injection wells in the fields. The injection systems would be designed and constructed in accordance with ANSI/ASME B31.8, "Gas Transmission and Distribution Piping Systems" standards and specifications or more stringent Amoco specifications. Portions of the system would be constructed using two different types of construction specifications. The Elk Basin, Little Buffalo Basin and Beaver Creek CO_2 injection systems would be constructed to meet Type A construction requirements except for above-ground piping. Portions of the Salt Creek Field in and around the towns of Midwest and Edgerton and all above-ground piping would be constructed to more stringent Type C construction requirements which would further reduce the risk of an accidental release of CO_2.

The CO_2 surge and injection pumps would be designed to pump CO_2 from the plant to the injection wells at pressures required for reinjection (1,200 to 2,200 psi). Liquid CO_2 from both the feed flash separator and methane stripper would be combined with CO_2 in the CO_2 surge tank. The CO_2 product pumps would pump CO_2 from the surge tank through a CO_2 metering skid and into the suction of CO_2 injection pumps. The injection pumps would pump the CO_2 into the injection trunkline. The system would integrate plant CO_2 output with the CO_2 spur or trunk pipeline and CO_2 injection requirements. The CO_2 surge and injection pumps would be located on the CO_2 recycle plant pad.

CO_2 would be transported from the plant to the injection wells through a series of 8- or 10-inch injection trunklines. The tie-in would be a welded connection. The injection trunklines would generally be Type A construction except for prefabricated lateral assemblies and at road crossings. Portions of the system constructed in or around the towns of Midwest or Edgerton would be constructed to meet Type C construction requirements.

Lateral assemblies (connecting individual injection wells with the injection trunklines) would be prefabricated and would meet Type C construction requirements and, as such, would be thicker walled than comparable Type A piping. Laterals would run from each lateral assembly to individual well sites. Laterals would be constructed primarily of 3-, 4- and 6-inch pipe. A CO_2 meter/control skid would be installed at each injection well to measure the CO_2 injection rate and to provide remote control of all injection activities from the plant control room.

Field Production Facilities. Production facilities serve as the primary point of oil, water and gas separation and transportation for field production in all four existing oil fields. Typically, these facilities are scattered throughout the field. Implementation of CO_2 flooding may require upgrading or replacement of some field

Table 2-8. Estimated Miles of Existing Producing and Injection Pipelines and Numbers of Producing and Injection Wells in the Fields Targeted for CO2 Flooding.

	Miles of Pipeline		Wells	
Field	Producing	Injection	Producing	Injection
Elk Basin	75	45	90	73
Beaver Creek	25	28	29	28
Little Buffalo Basin	90	65	176	40
Salt Creek	195	182	1000	700
Total	385	320	1295	841

production facilities in some fields. Each facility replaced or upgraded would consist of a two-phase separator, one or two three-phase separators, one to four production heater skids and related metering, valving and connecting piping. Permits necessary for construction and operation of these facilities would be filed with the BLM, as appropriate.

Production flowlines would be used to connect producing wells and production facilities. Each well would have an individual flowline; however, flowlines would occupy common ditches wherever practical. Production facilities and main batteries would be connected to the CO_2 recycle plants. The system would share a common ditch with production flowlines wherever practical.

2.5 CONSTRUCTION

2.5.1 Pipelines

Construction procedures for all spur and trunk CO_2 pipelines would be the same. Wellfield injection and producing pipelines would be similarly constructed. Construction activities have been scheduled for summer months. Crews utilized during construction of spur and trunk pipelines are expected to work six days a week and construction will progress at an average rate of approximately two miles daily.

CO_2 pipelines would be constructed using the same techniques employed during the construction of other gas pipelines. Typically, pipelines are laid in a continuous spread which consists of equipment and crews handling various phases of construction for a given pipeline segment. All spur and trunk pipelines would be constructed in a single continuous spread except for the Elk Basin CO_2 Trunk Pipeline, which would require two construction spreads in order to complete construction in a single construction season.

Amoco would secure the services of a private contractor to construct all the pipelines and would issue that contractor detailed pipeline construction specifications and provide the contractor with all the necessary permits, including the right-of-way grant to cross public and private lands. The contractor would be required to have on location and maintain an up-to-date set of plans and specifications. The Bureau of Land Management would be provided with all plans and specifications and would receive updated information throughout the planning, permitting and construction phases of the pipelines.

Typically, pipelines are laid in a continuous operation. The following is a list of major activities required during construction of a pipeline, in order of occurrence:

- o Clearing;
- o Topsoil stripping;
- o Trenching;
- o Stringing, lineup, welding, radiographic inspection;
- o Lowering in;
- o Backfilling trench;
- o Hydrostatic testing;
- o Cleanup and restoration.

A typical pipeline construction spread is illustrated on Figure 2-15. A cross section of Amoco's proposed right-of-way configuration for spur and trunk pipelines appears on Figure 2-16.

Amoco has requested a 50-foot permanent right-of-way for spur and trunk pipelines. An additional 25 feet would be necessary to allow a safe working space during construction. The 50-foot offset from existing pipelines proposed by Amoco is necessary to eliminate cathodic protection interference with other pipelines and to protect existing pipelines during construction. Where necessary (i.e., in areas of steep terrain or on side hill cuts), the entire 75-foot construction right-of-way would be cleared of vegetation and graded to provide a safe working

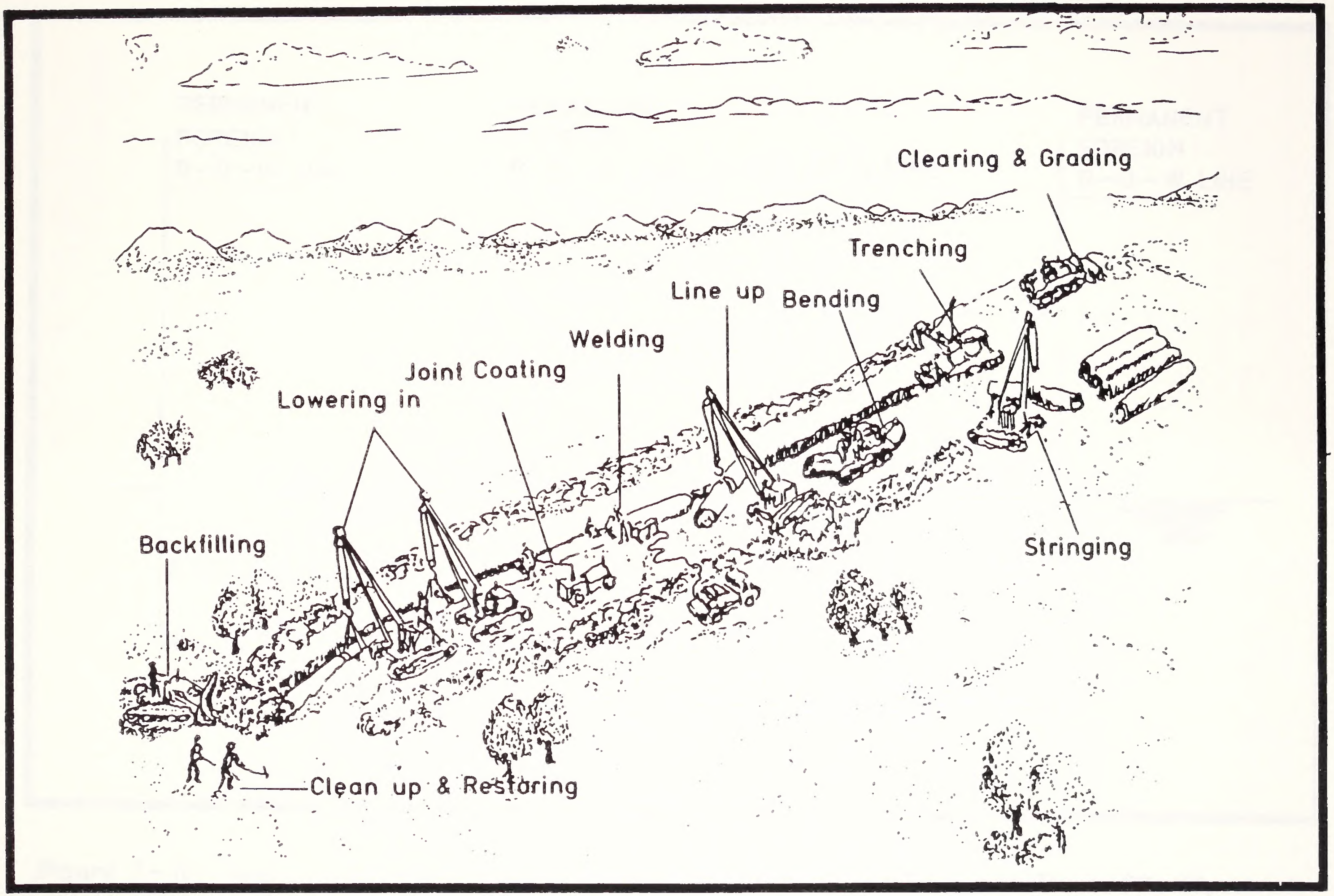


Figure 2—15. Typical Pipeline Construction Spread.

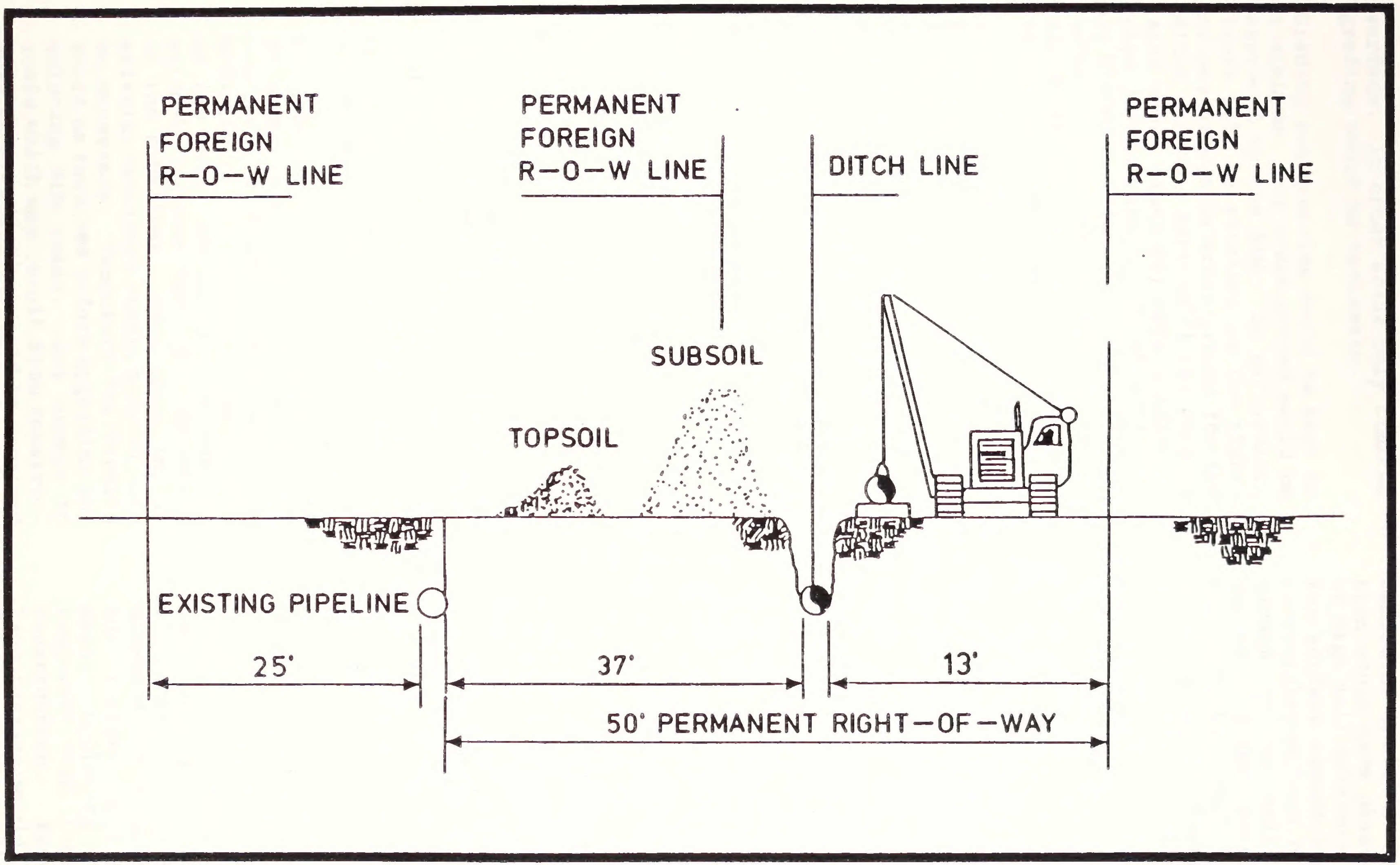


Figure 2—16. Amoco's Proposed Right—of—Way Configuration for Spur and Trunk CO_2 Pipelines.

surface. In other areas only limited grading would be necessary.

Grading and clearing would be kept to a minimum. Any areas graded would be approved by the BLM. In particular, brush will be retained in the right-of-way except in areas graded for the ditch and on a portion of the working side where brush may make welding of pipe joints unsafe. Brush would not be bladed in areas of crucial wildlife *habitat*--a brush beater may be used to allow vehicles to travel on the right-of-way in these areas.

Amoco would require its contractor to arrange for the maintenance and servicing of equipment to avoid damage to the right-of-way and adjacent properties. Oil drained from equipment would not be permitted to spill on the ground. All waste oil, containers, skids, scrap pipe cuttings, welding electrodes and other refuse would be collected at the end of each working day and hauled to approved landfills for disposal. All waste material generated during construction of the pipeline would be disposed only in authorized waste disposal sites. Amoco would confer with the Wyoming Department of Environmental Quality-Solid Waste Management Program to determine the suitability of local landfills for disposal of construction wastes. Characterization (including analysis of chemical constituents of the waste) may be necessary prior to disposal. The contractor would be required to provide portable sanitary facilities from a qualified firm for use by the workers.

All spur and trunk pipelines proposed by Amoco would parallel or bisect numerous existing roads for the majority of the routes. Therefore, no new road construction is anticipated during construction or operation of the pipelines. Some upgrading of existing two-track roads, however, may be necessary. Temporary Use Permits would be required before upgrading any existing BLM roads. Any damage to roads which may result from construction of the pipeline would be repaired to original condition by Amoco. No vehicular travel or equipment operation would take place during periods of high soil moisture conditions when the surface cannot support equipment or vehicles without causing excessive damage to the soils (generally in excess of 3-inch ruts). Travel along the corridor would be restricted to existing rights-of-way, roads and jeep trails.

Amoco, at the direction of the Authorized Officer, would construct physical barriers to control *off-road vehicle* use of the right-of-way after construction is complete. Amoco would not lock or close gates or cattle guards on established roads on public lands unless the gates or cattle guards were originally locked or closed.

The pipeline right-of-way would be used for access only during construction and maintenance of the pipelines. Periodic use of the right-of-way would be necessary during maintenance operations to inspect valves and cathodic protection systems. No other use would occur without prior approval by the Authorized Officer.

During construction of the pipelines, Amoco would comply with existing federal, state, county and private requirements developed to protect road networks. Load limit restrictions would be observed at all times to prevent damage to the road surface. Special arrangements would be made with the Wyoming Highway Department and county governments, as appropriate, to transport oversize and heavy loads.

Permittees and other regular users and developers of public lands along the right-of-way would be notified in advance of construction activities that could affect their business or operations. Notification to landowners would be given by mail. Other notification would be made by various means, including placing signs at temporary road closures in advance of construction. Ranchers and public land lessees would be advised of any fence openings or disturbance to range

improvements or other range use-related structures in advance of construction.

Amoco's contractor would place and maintain ditch line stakes, slope stakes, culvert location and grade stakes, and other control stakes necessary to ensure construction of the pipelines in accordance with all technical information submitted in the right-of-way grant application and PODS. If the stakes are disturbed for any reason, they would be replaced before proceeding with construction of the pipelines.

Before initiating construction, the contractor would move all survey stakes back to the edge of the right-of-way and preserve them during all phases of construction. After construction of the right-of-way is complete and the ditch backfilled, the contractor would restake the ditch line at the original location of the survey stakes.

Functional use of all livestock use facilities and other public improvements would be maintained at all times. Temporary gates would be installed in every functional fence traversed by the right-of-way alignment. Fences would be reconstructed in a condition equal to or better than the original condition. If a natural barrier used for livestock control were damaged during construction, the area would be adequately fenced to prevent the escape of livestock. No gates on established roads over public lands would be locked, blocked or closed. Any cattle guards or gates damaged during construction would be repaired to their original condition.

Conduits would be installed, as necessary, to maintain natural drainage when constructing temporary fills for passage of equipment. Such conduits would be maintained throughout construction to allow drainage and protect against damage on adjacent properties.

During clearing and grading, boulders, rocks, shrubs, trees and other obstacles would be removed from the right-of-way. Clearing and grading would be conducted to a minimum width necessary for construction equipment to operate safely and efficiently without unnecessary damage to the right-of-way. The right-of-way would be graded so as to minimize the need for fabricated sag bends or overbends. The objective, insofar as practical, is that grading and ditching be performed in such a manner as to allow the pipe to conform naturally to the finished ditch.

Grading at road, railroad, river, stream, canal, gully, ditch and other crossings within the right-of-way would be of sufficient width to allow the safe passage of construction equipment and vehicles. Grading would be conducted in such a manner as to minimize interference with existing natural drainage. Where terraces or water diversions are cut, restoration would be expedited.

During trenching, the contractor would excavate the ditch along the staked ditch line. The finished ditch would be free of rocks, hard clods, stumps, roots or other debris which could injure the coating when the pipe is lowered into the ditch. All tree roots would be cut flush with the side walls and bottom of the ditch to prevent contact with the pipe. The bottom of the ditch would be graded and dressed so that the pipe would have a continuous and uniform bearing.

Typically the trench would be double ditched, with the first cut into the trench removing topsoil which would be stockpiled onto the non-working side of the right-of-way. Later cuts in the ditch would remove subsoil which would be stored in a separate stockpile on the non-working side of the right-of-way (see Figure 2-16). Care would be taken to assure that stockpiled topsoil and subsoil are not allowed to mix. Areas where there is insufficient topsoil to make double ditching practical would be identified in the POD. Any special reclamation techniques required for these areas would also be discussed. Topsoil

salvage techniques other than double ditching may be used if approved in the POD.

The contractor would excavate the ditch in such a manner as to minimize the number of bends required to lay the pipe by cutting the ditch slightly deeper at the crest of ridges and gradually cutting the ditch deeper in approaches to terraces, watercourses, etc. At such locations, the ditching machine would be operated at various depths rather than grading the ditch by other means. Where over bends or side bends are required, the ditch would be excavated to provide proper clearance between the inside bend of the pipe and the bottom or side of the ditch. Foreign material would not be allowed to mix with soil used to backfill the trench.

If blasting is necessary, Amoco would obtain necessary permits (including Bureau of Alcohol, Tobacco and Firearms permits which are mandatory) and notify regulatory authorities as well as occupants of nearby buildings, houses or places of business within a quarter mile of the blast site. Ranchers would be notified in sufficient time to protect property or livestock. In performing blasting operations, Amoco would employ qualified personnel that are experienced in the handling of explosives. The contractor would excavate to obtain only the depth required and will blanket the ditch with spoil or blasting mats to contain the blast.

If rock is scattered over the right-of-way or adjacent property during the blasting operations, Amoco would clean up the rock, haul it from the premises or bury it to the satisfaction of the landowner. Amoco would use extra precautions in blasting near telephone, telegraph, or electrical conduits, water lines, water wells, pipelines or other underground structures.

The depth of the ditch would vary with the conditions encountered. The cover from the top of the pipe to ground level would be a minimum of three feet. At the state highway crossings, the pipe crossing would be bored to conform to regulations of the Wyoming Highway Department (see Figure 2-17). Railroad crossings would be similarly bored. Tires, planks, or other suitable buffers would be used when crossing roads and highways with equipment to prevent road damage. Amoco would be responsible for repairing any damage that occurs. Amoco would keep all road and highway surfaces free of dirt, rock, oil or debris that could be a hazard to the public.

At state highways, crossings would be dry bored in conformance with requirements of the Wyoming Highway Department. Boring involves the use of a machine which feeds drill or dummy pipe into a hole bored under the highway. Pipe would then be fed into the hole directly in back of the cutter blade in the auger. Under no circumstances would boring activities be conducted within the road or highway right-of-way limits. Pipe installed under roads and highways would not be cased. The pipe would be buried a minimum of four feet below the top of the road or highway and the lowest point of the borrow ditches.

To reduce the likelihood of accidents, ditching operations would be timed so that the ditch is not open for more than 14 days. Where an open ditch would interface with cut roads, an unexcavated ditch line would be provided to allow safe and unimpeded passage across the right-of-way. When necessary, traffic control measures would be implemented to ensure public safety.

The proposed CO_2 spur and trunk pipeline alignments would cross the Shoshone, Greybull, Big Horn and Sweetwater rivers. The pipelines would be buried in a trench at these crossings. Amoco has aligned the pipelines to minimize impacts on riparian vegetation at all river crossings.

Construction of all major river crossings would occur during low flow in the fall or winter but would be

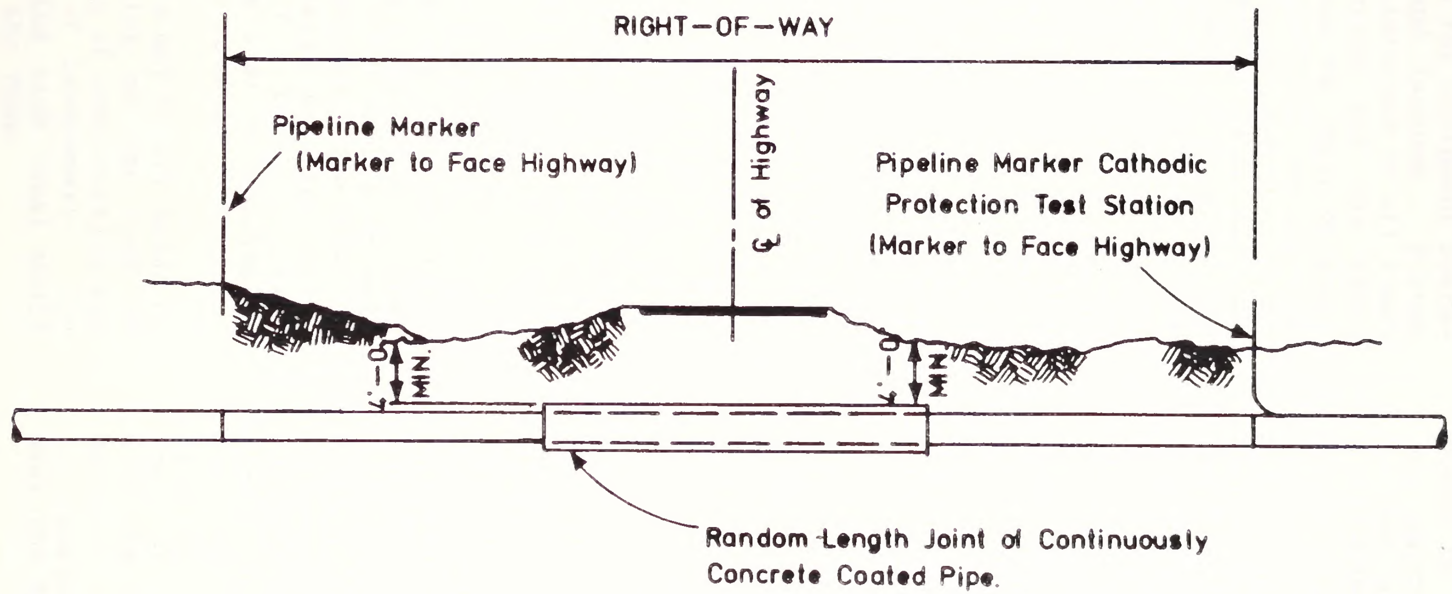


Figure 2—17. Profile of a Bored, Uncased Paved Road Crossing.

restricted to times which do not coincide with fall trout spawning. The pipeline trench would be built across the rivers at right angles wherever possible. Staging areas (200 feet x 400 feet) would be required on both river banks for equipment operation, welding and laydown. Stream flow would be maintained at all times during construction and the banks would be reclaimed to their original profiles and stabilized to minimize erosion. Amoco would consult with the Wyoming Game and Fish Department and the BLM to determine an appropriate seed mixture for reclaiming river banks. The ditch would be dug by backhoe and/or dragline. Spoil from the excavation would be placed in locations as specified by U.S. Army Corps of Engineer's Nationwide Section 404 Permit. The pipe would be buried deep enough so that high water will not affect the pipe through scour action but no less than five feet below the river bed (see Figure 2-18). During backfilling, spoil would be distributed in such a manner that the river bed would be similar to its original contour with no impediment to normal flow of water. River banks would be restored to resemble their original grade and rip rap would be placed over the pipeline on both banks, if necessary. Rip rap would be placed from the top of the bank to the low water line.

The pipeline would be welded on one bank of the river before the trench is dug to reduce the time the river is open. Radiography would be used to inspect all field welds in submerged river crossings. The pipeline would then be placed into the trench and weighted with a 1-inch concrete jacket to ensure that it remains in the trench until covered.

Irrigation canals may be dry bored or trenched depending on the type of canal, the timing of construction and the preference of landowners. The method of crossing each canal would be addressed in the PODs.

When the ditch is excavated through areas where livestock are confined and where it is desirable for the landowner or tenant to have a passageway across the ditch, Amoco would provide a dirt plug for crossing the ditch wherever necessary. All drain ditches and watercourses would be kept open and functional. Any obstructions, such as dirt, would be removed from ditches and watercourses immediately after construction in the area is complete.

Before installation, as required by ANSI B31.8, a minimum of 10 percent of the welds would be radiographically inspected. All welds under state and county highway crossings, railroads and rivers would be radiographically inspected. No pipe would be lowered until the ditch is free from loose rock, hard clods, roots or debris which could damage the coating. Necessary slack in the pipeline would be obtained by lowering sections into the ditch while alternate sections are held above the ditch on skids. Slack loops would be held up only as necessary to obtain a proper fit in the ditch to prevent pushing the pipeline ahead. After the necessary backfilling has been completed to hold bends in their proper position, slack loops would be lowered.

Backfilling would be performed by means of a blade. Topsoil and subsoil would be kept segregated during backfilling. No foreign substances, including skids, welding rods, containers, brush, trees or refuse of any kind would be permitted in the backfill. Earth, sand or other soft and loose material that does not contain rocks or hard clods would be backfilled directly on the coated pipe. An illustration of a backfilled trench is provided in Figure 2-19. After the ditch has been filled to the level of the surrounding ground, one wheel of a tractor tire would be run over the ditch to pack and lower the backfill. After this is completed, the remaining topsoil would be spread over the ditch.

Ditch excavated in loose or solid rock would be backfilled in a manner that will not damage the pipe or coating.

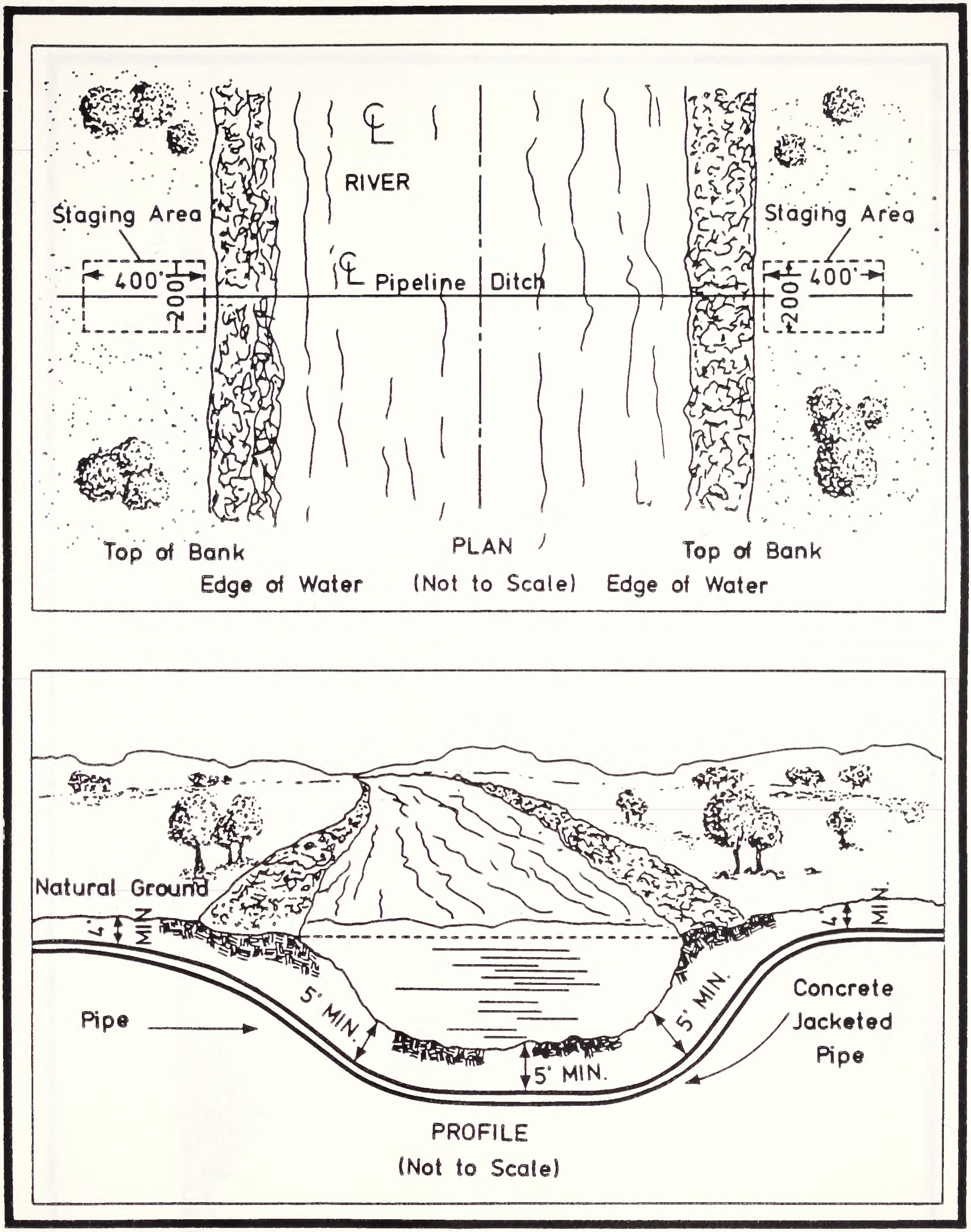


Figure 2—18. Plan and Profile of Typical Pipeline River Crossing.

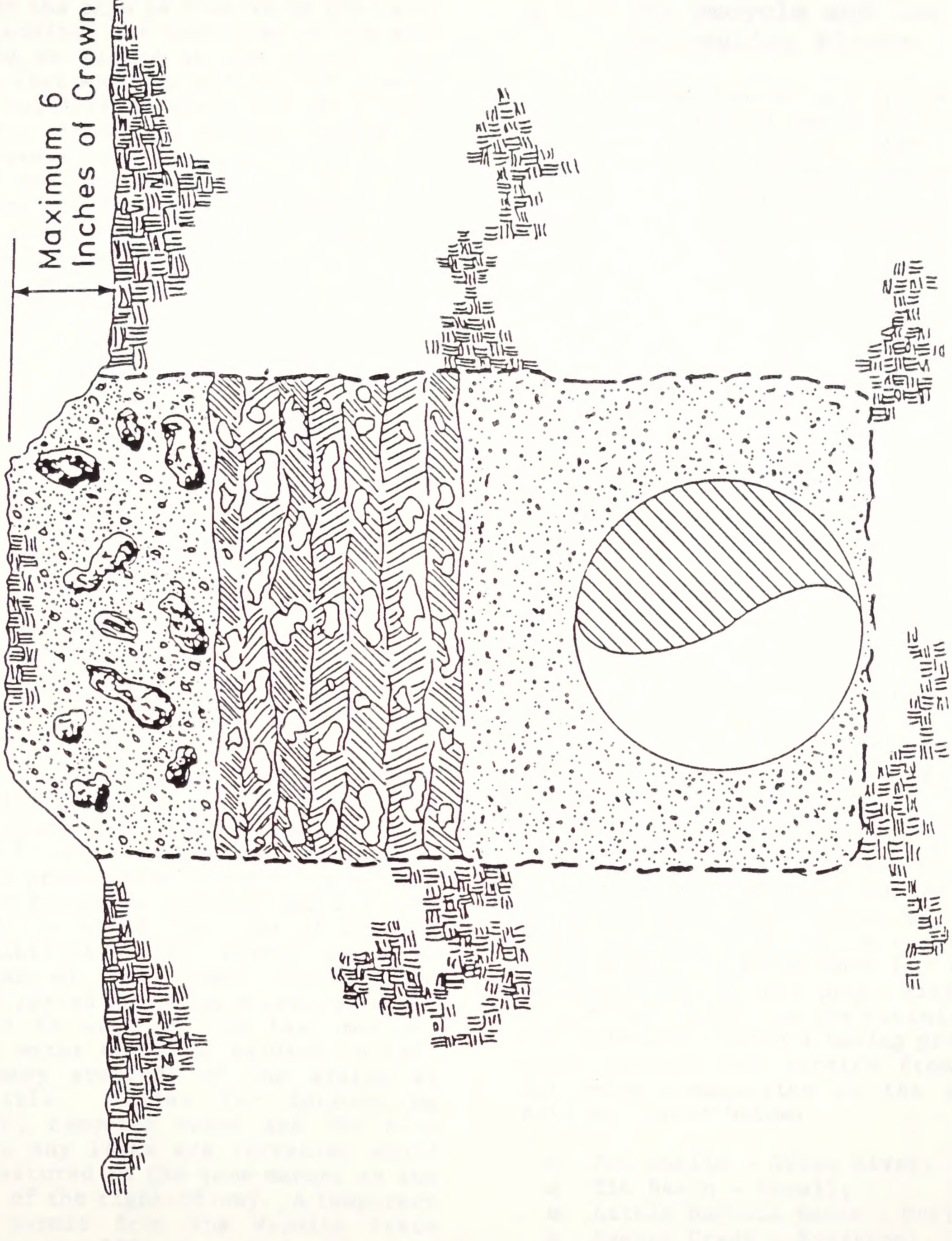


Figure 2—19. Completed Trench Cross Section.

No rocks, hard clods or other hard objects would be placed on the coated pipe. The pipe would be covered with soft earth or Rock Shield before any rocks or hard objects are placed in the ditch.

After the pipe is covered by the layer of padding, the remainder of the soil would be placed in the ditch. Any rock that would interfere with plowing and cultivation would not be allowed in the ditch. If borrow material is necessary, Amoco would purchase the dirt from an existing source, eliminating the need for development of an additional borrow source on Bureau of Land Management-administered lands. Amoco would place a crown over the pipeline trench. The crown would not exceed 6 inches in height (see Figure 2-19). The top of the crown would be flattened and seeded. If topsoil is necessary to create the crown, Amoco would purchase the material from an existing source. All revegetation activities would be conducted in the fall. As soon as backfilling is completed, the right-of-way would be cleared of any remaining waste materials, debris and rocks. All holes and ruts would be filled and smoothed and the land surface restored to its preconstruction condition. All temporary fills and conduits would be removed and the area generally cleaned up.

Once the pipe is in place, the continuity of the system would be tested to locate any leaks or weak spots. Such a test would comply with regulations promulgated in Part 192 (applicable standards 192.505 and 192.619) of Title 49 of the Code of Federal Regulations. The system would be tested at 1.25 times the maximum anticipated operating pressure. Water would be used as the test medium. Test water would be re-used to test as many sections of the system as feasible. Sites for introducing water, removing water and the site where any leaks are corrected would be restored in the same manner as the rest of the right-of-way. A temporary use permit from the Wyoming State Engineer's Office would be obtained prior to water use, if necessary. After testing is complete, the water would be surface discharged in compliance with Wyoming Department of Environmental Quality rules.

2.5.2 CO_2 Recycle and Gas Processing Plants

All construction of gas processing and recycle plants would be awarded to private contractors. Each plant pad would consist of approximately 40 acres. The Elk Basin and Beaver Creek plants would be constructed immediately adjacent to existing plants in these fields.

Most process facilities would be enclosed in buildings for protection. Existing access in the Elk Basin, Beaver Creek, Little Buffalo Basin and Salt Creek fields would be used throughout construction and operation of the plants. Additional access (approximately three miles) would be necessary for construction and operation of the Fontenelle Plant.

Earthwork necessary to construct the plant sites would require approximately three weeks to complete. Plant construction would be scheduled to begin after earthwork is complete.

During construction, access and vehicular traffic would be regulated to protect the public, wildlife and livestock from construction hazards. Free and unrestricted access to the construction sites would not be permitted during construction of any project components. Amoco has proposed to bus workers during construction to eliminate the need for large parking areas at the plant site and to control traffic in the vicinity of construction. Amoco's busing program would provide bus service from the following communities to the plant site as listed below:

- Fontenelle - Green River;
- Elk Basin - Powell;
- Little Buffalo Basin - Worland;
- Beaver Creek - Riverton;

o Salt Creek - Casper.

The proposed busing program would also serve to direct the *inmigrant workforce* to communities where adequate housing is available and should eliminate overtaxing of public services and facilities where capacity is not available. Amoco successfully used this *mitigation* measure to protect the small town of Bairoil during construction of the Bairoil CO_2 Project in Carbon and Sweetwater counties during 1986.

Construction of any major project has the potential to cause impacts to communities. To mitigate the potential impacts to communities, Amoco has agreed to implement a local hiring program. The intent of the program is to maximize the use of local labor during construction of the CO_2 projects. To achieve this goal, Amoco would utilize local Wyoming Job Service centers in the project areas to collect employment applications and provide preliminary screening of potential workers. The contractors would be required to coordinate their hiring needs with the Job Services center and would not be allowed to open employment offices in the communities or at the project site. During construction of the Bairoil Project, local labor played a substantial role in construction of all project components. The average percentage of local labor in the workforce during construction of the Bairoil Project was 75 percent. By implementing the same hiring policies developed for the Bairoil Project, Amoco could expect similar local labor participation during construction of the five CO_2 projects.

Requirements for field construction would vary sharply between projects due to the major differences in the size and number of wells associated with the fields. Table 2-9 provides projected workforce requirements for each project.

Aggregate for concrete and structural fill for the plant and field facilities would be obtained from private sources. Water for compaction, dust abatement and plant construction would be obtained from existing water sources in the fields or from additional sources in accordance with appropriate state rules and regulations. Permits from the Wyoming State Engineer's Office would be obtained prior to use of any water.

All grading of the plant and field facilities would be controlled by a plant and field site survey. Earth movement would be controlled by ground stakes, on which cut or fill requirements would be noted. Elevation and position of foundations, underground utilities, piping and electrical lines would be controlled by survey stakes. The centerline and outside boundaries of the right-of-way for linear facilities would be staked and flagged. Each stake would have the facility name and alignment station number written on it.

Following completion of the construction survey, the plant site would be stripped of all topsoil. The topsoil would be stockpiled and used for *reclamation* in other locations in the field. Three inches of gravel would be spread over the plant site near buildings and equipment. The plant site would be graded, as necessary, to allow surface water runoff from rain and snow to flow to an underground sump where it would be pumped to the waste water storage sump. Earth or rock materials would be excavated to the line grades and elevations required for proper construction of the facilities. Trench excavation for utilities and pipelines within the plant would be determined by the contractor during construction. Piping between plant process vessels would be mostly constructed above ground, with very little piping buried.

Underground lines for sanitary sewers, storm sewers, miscellaneous drains, water lines and electrical lines would be installed. These systems would be installed in excavated trenches and tested before the trenches are backfilled.

Table 2-9. Workforce Projections for Construction and Operation of the Proposed Projects.

Project/Component	1989 2Q	1989 3Q	1989 4Q	1990 1Q	1990 2Q	1990 3Q	1990 4Q	1991 1Q	1991 2Q	1991 3Q	1991 4Q	1992 1Q	1992 2Q	1992 3Q	1992 4Q	1993 1Q	1993 2Q	1993 3Q	1993 4Q
FONTENELLE PROJECT																			
Gas Processing Plant																			
Construction	110	330	400	480	310	160	50												
Operations	0	0	0	0	0	8	8												
Field Facilities																			
Construction	30	80	40	40	80	80	0												
Drill Crews (a)	135	135	135	135	0	0	0												
Total Construction (b)	140	410	440	520	390	240	50												
Total Operation	0	0	0	0	0	8	8												
TOTAL FONTENELLE WORKFORCE	275	545	575	655	390	248	58												
ELK BASIN PROJECT																			
Recycle Plant																			
Construction	0	0	0	0	120	350	450	500	320	110									
Operations	0	0	0	0	0	0	0	0	6	6									
Field Facilities																			
Construction	40	120	50	50	100	90	50	0	0	0									
Trunk Pipeline (c)	0	0	0	0	240	320	120	0	0	0									
Construction																			
Operations	0	0	0	0	0	2	2	2	2	2									
Total Construction (d)	40	120	50	50	460	760	620	500	320	110									
Total Operation	0	0	0	0	0	2	2	2	8	8									
TOTAL ELK BASIN WORKFORCE	40	120	50	50	460	762	622	502	328	118									
BEAVER CREEK PROJECT																			
Recycle Plant																			
Construction									0	0	0	170	210	270	100	80	20	0	
Operations									0	0	0	0	0	0	0	6	6	6	
Field Facilities																			
Construction									40	80	40	20	70	100	80	0	0	0	
Trunk Pipeline																			
Construction									0	0	0	0	160	160	0	0	0	0	
Operations									0	0	0	0	0	0	2	2	2	2	
Total Construction (d)									40	80	40	190	440	530	180	80	20	0	
Total Operation									0	0	0	0	0	0	2	8	8	8	
TOTAL BEAVER CREEK WORKFORCE									40	80	40	190	440	530	182	88	28	8	

Table 2-9. Continued.

Project/Component	1992 1Q	1992 2Q	1992 3Q	1992 4Q	1993 1Q	1993 2Q	1993 3Q	1993 4Q	1994 1Q	1994 2Q	1994 3Q	1994 4Q	1995 1Q	1995 2Q	1995 3Q	1995 4Q	1996 1Q	1996 2Q	1996 3Q	1996 4Q	1997 1Q	1997 2Q	1997 3Q	1997 4Q
LITTLE BUFFALO BASIN PROJECT																								
Recycle Plant																								
Construction		0	0	0	170	210	270	100	80	20	0													
Operations		0	0	0	0	0	0	0	6	6	6													
Field Facilities																								
Construction		30	80	50	40	120	100	0	0	0	0													
Spur Pipeline																								
Construction		0	0	0	0	100	100	0	0	0	0													
Operations		0	0	0	0	0	0	0	0	0	0													
Total Construction (e)		30	80	50	210	430	470	100	80	20	0													
Total Operation		0	0	0	0	0	0	0	6	6	6													
TOTAL LITTLE BUFFALO BASIN		30	80	50	210	430	470	100	86	26	6													
SALT CREEK PROJECT																								
Recycle Plant																								
Construction							0	100	200	300	250	110	0	0	0	0	0	0	0	0	0	0	0	0
Operations							0	0	0	0	6	6	6	6	6	6	6	6	6	6	6	6	6	6
Field Facilities																								
Construction							0	150	150	190	160	60	80	300	250	70	90	340	390	60	80	200	280	150
Spur Pipeline																								
Construction							0	0	0	60	80	0	0	0	0	0	0	0	0	0	0	0	0	0
Operations							0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Construction (e)							0	250	350	550	490	170	80	300	250	70	90	340	390	60	80	200	280	150
Total Operation							0	0	0	0	6	6	6	6	6	6	6	6	6	6	6	6	6	6
TOTAL SALT CREEK WORKFORCE							0	250	350	550	496	176	86	306	256	76	96	346	396	66	86	206	286	156

a - Based on 10 wells; 5 rigs; 6 months spud to spud; 27 drillers/well.
b - Plant and field construction workforce.
c - Workforce projections based on two spreads operating simultaneously.
d - Plant, field and trunk pipeline construction workforce.
e - Plant, field and spur pipeline construction workforce.

Sanitary sewer systems would be built at sites without an existing system. The sanitary system would be a gravity drain system. All sanitary sewer lines would be installed below water lines with a vertical separation of not less than one foot. Storm drains would be installed to carry all storm water which cannot be drained by the surface drainage system. Water lines would be installed to carry potable water, fire water and utility water to the buildings.

Concrete foundations would be installed for proper support of structures, equipment and piping. Foundations would be set on undisturbed soil. Foundation excavations would be kept free of water, ice and debris prior to concrete placement. Standard industry practices would be used for concrete placement, finishing and curing techniques.

Form work would be sufficiently strong and tight to prevent excessive deflection or leakage of mortar. Safety of form work would be ensured by adequate bracing, shoring and anchorages which would be performed to prevent damage to concrete. Forms would not be removed until the concrete has reached a strength of 3,000 psi to safely support its own weight and applied loads.

Once the concrete has had sufficient time to cure, above-ground facilities would be constructed. The building framing would be erected and most of the sheathing applied. Equipment would be transported to the site from the manufacturer's shop. After the equipment is lifted into place, grouted and anchor bolts tightened, the remainder of the sheathing would be applied. The piping and electrical tie-ins would then be made.

Temporary bracing and guying would be adequate at all times to resist wind and other live loads. All necessary field connections would be securely bolted and welded to support all dead, live and erection loads prior to removal of temporary braces or guys.

Grout would be installed under equipment bases to provide support for equipment on concrete or structural steel. Grout would also be placed under structural steel base plates to provide bearing and load carrying capacity between foundations and the supported structure.

All plants would be enclosed by a galvanized, chain link safety fence. One-way panic gates would be installed in fences at critical areas to provide emergency exits from the plant. Electrically operated gates would be provided at each of the plant access points.

All drainage from the plant site and within plant process or utility buildings would be either recovered for use or disposed of in a well. Each of the plant process and utility buildings would be provided with a concrete open drain system to collect floor drain runoff and nonvolatile process equipment and instrument fluids. In addition, closed drainage systems would be provided for fluid drains containing sour or volatile compounds and for valuable fluids which may be recovered (e.g., LO-CAT solutions and TEG).

All liquids from the open drain system, effluent from caustic neutralization and blowdowns from the steam boilers and water treating units would be collected in the waste water storage tank. From the storage tank, waste water would be pumped by a waste water charge pump through a waste water backwash filter to a waste water injection pump. The injection pump would discharge to an off-site disposal well permitted through the Wyoming Department of Environmental Quality. An oxygen scavenger would be added into the charge pump suction line to prevent aerobic bacteria growth and corrosion in the disposal well. Hydrocarbon drains from closed sumps would be pumped to field production facilities for extraction and sales.

A buried cement sump would be constructed to collect runoff from the

plant sites. All water collecting on the plant sites would be diverted to the collection system. Water from sumps would be pumped to disposal wells for final disposal.

Each plant would be equipped with a flare to dispose of gas streams from the LO-CAT unit which would contain small quantities of H_2S (approximately 5 ppm) and volatile organic compounds (approximately 100 ppm). Streams to be flared would enter the flare header through various relief valves and pressure control valves in the plants. The gas would pass through a flare drum where entrained or condensed liquids would be separated. Air to the flare stack would be provided by the flare stack blower to ensure smokeless combustion. When required to assure combustion, a flow element located in the inlet gas stream to the flare would be utilized to proportion purchased or produced gas or propane to flare combustion assist rings. All vent gas streams containing H_2S, as well as large vent streams containing more than 10 percent volatile organic compounds (such as propane and heavier hydrocarbons), would be flared. Safety valve discharges, which do not contain H_2S, would be vented directly to the atmosphere.

The flares would be designed to combust the entire plant inlet feed rate (150 MMSCFD) if emergency situations occurred. Under emergency conditions, however, the gas to flare may contain up to 95 percent noncombustible CO_2. Combustion assist rings, which introduce propane or purchased or produced gas for auxiliary firing, would be used when the BTU content of the flared stream, by itself, would be too low to allow combustion. The flare stack at each plant would be approximately 100 feet in height. Flares would be designed to totally combust all oxidizable compounds in the flare gas. The smokeless design would prohibit smoke density from exceeding No. 1 Ringleman for three minutes in each 60-minute period during routine operations. All plant emissions would be permitted with the Wyoming Department of Environmental Quality--Air Quality Division.

Testing of materials, installation procedures and completed systems would be conducted to ensure compliance with applicable codes and standards. These test procedures are specified in such standards as the American Society of Testing Materials, American Petroleum Institute, American National Standards Institute and National Association of Corrosion Engineers. Testing would be performed by independent testing laboratories or at the manufacturer's testing facility. Appropriate plant components would be tested at a minimum level of 1.25 times greater than anticipated maximum operating pressures.

After construction of the plants is completed, the construction area would be cleaned up. Wastes would be disposed of in accordance with Wyoming Department of Environmental Quality-Solid Waste Management Program rules and regulations. Construction wastes would be disposed of promptly and only in an approved manner. Temporary facilities would be dismantled and removed from the plant sites. Depressions, except drainage channels, would be filled. The area would be graded to smooth grades to minimize ponding and erosion of the surface.

The plants and field facilities would be constructed in a safe manner. Necessary precautions would be taken to provide adequate protection for the health and safety of life and the protection of public and private property. All applicable health and safety requirements prescribed by law and regulation would be incorporated into construction and operations procedures.

2.6 OPERATIONS AND MAINTENANCE

2.6.1 Pipeline Monitoring and Maintenance

The spur and trunk pipelines would be monitored via an existing satellite

communication system (SCADA System). Status of the pipelines would be transmitted to Amoco's pipeline control center in Tulsa, Oklahoma. Pipeline operations would also be monitored in each of the plant control rooms. The systems would continuously monitor pipeline pressure and flow conditions and control centers would be manned 24 hours daily. Alarms would sound in control centers if pipeline pressure (indicative of a rupture) dropped. Automated valves could be closed anywhere along the system to isolate the release.

At least annually, inspections of the pipelines would be conducted using aerial patrols. These patrols are designed to locate any areas where the pipeline corridor is experiencing heavy erosion or conditions which might compromise the integrity of the system. In addition, cathodic protection tests would be conducted for each pipeline annually at test lead locations installed during construction. Cathodic tests are conducted to assure that the installed cathodic protection system is functioning properly and that excessive pipeline corrosion is not occurring.

2.6.2 Plant Operation and Maintenance

The Fontenelle Gas Plant would remove H_2S and dehydrate the CO_2 produced from the Raptor Field. The plant would have an inlet feed capacity of 150 MMSCFD and is expected to operate continuously for a 20-year period. Acid gas from the selexol unit would be reinjected into the Madison Formation. The plant would be designed as a zero-discharge facility and, as such, would not discharge waste products through surface discharge points. A flare would be included in the plant design should it become necessary to flare the inlet in an emergency situation. Plant emissions would consist of hydrocarbons from pressure release valves and other over-pressure relief points.

The CO_2 recycle plants are similarly designed as zero-discharge facilities. The plants would be designed to remove H_2S; recover sulfur; recover natural gas liquids; and separate CO_2 for reinjection into the producing formations. All plants would have an inlet processing capacity of 150 MMSCFD and would be designed to operate for a 15- to 20-year period. Emissions from the recycle plants would consist primarily of small quantities of H_2S (approximately 5 ppm) from the LO-CAT and hydrocarbons from a variety of vents throughout the plant.

2.6.3 CO_2 Pipeline Rupture Scenario

It is impossible to predict the frequency or size of leaks that could occur along a CO_2 pipeline because few CO_2 pipelines exist and there is no historical data base for evaluating these types of incidents. However, based on other types of natural gas pipelines, an average rupture frequency of 1 rupture per 10,000 miles of pipeline per year could be expected. Most ruptures are caused by heavy equipment operations near the pipeline and other outside forces. According to the U.S. Department of Transportation (1985), 61 percent of the pipeline ruptures in the United States in 1983 occurred as a result of third-party damage. It can be reasonably assumed, as a result of advances in pipeline technology and the rural location of most of Amoco's proposed CO_2 pipelines, that the probability of a rupture is somewhat reduced below the 1 rupture per 10,000 miles estimate for all natural gas pipelines.

Since CO_2 is nonflammable, no explosion or fire would occur during a pipeline rupture. However, flying soil, rocks and other debris could occur as a result of the depressurization of the pipeline.

Concentrations of CO_2 in the atmosphere near a release could be very high immediately following the event.

The exact concentration would depend on how quickly the CO_2 is liberated from the pipeline. Since CO_2 is slightly heavier than air, some settling of the CO_2 in low areas could be expected. In the area near the release, a concentration which could be life threatening could occur for a limited period of time. However, immediately following the incident, the CO_2 would begin to disperse and the concentration in the area would be expected to quickly decline to non-life threatening concentrations.

If a rupture occurred at a stream crossing, the escaping CO_2 plume would spread and be diluted by dispersion as it is swept downstream. A small amount of gas would go into solution with most of the gas bubbling to the surface. Under standard conditions, at 25°C, equilibrium concentration would be 0.55 mg/l. Adjacent to the leak, supersaturation could occur with concentrations as high as 1,500 mg/l. The volume of water saturated would depend on the flow of the stream, the size of the rupture and amount of CO_2 released.

Pinhole leaks during operation of the pipelines could occur but would not result in adverse impacts to the environment. In some cases, such a leak could go unnoticed if the resulting pressure drop in the pipeline was below the threshold (approximately 150 psi) established by the operations center to trigger alarms.

2.7 ABANDONMENT

When the CO_2 floods are complete, after approximately 20 years, all surface facilities would be removed and the pipelines plugged or removed (purging is not required), wells plugged and abandoned and all disturbed areas reclaimed. Prior to abandonment, Amoco would be required to notify the BLM and submit an abandonment plan which would detail all actions associated with abandonment.

2.8 SUMMARY OF IMPACTS

Tables 2-10 and 2-11 provide a summary of the major resources affected by the proposed projects and their alternatives. <u>Qualitatively</u>, all of the proposed CO_2 flood projects (Elk Basin, Beaver Creek, Little Buffalo Basin and Salt Creek) and their alternatives have the same impacts because these impacts are a function of pipeline, recycle plant and wellfield construction activities common to them all. The significance of impacts is related to the type of environment into which the project is being introduced. Since all of the CO_2 flood projects would occur in developed oil fields with supply pipelines following existing pipeline corridors, the seriousness of the impact is reduced in all cases. <u>Quantitatively</u>, the impacts differ among projects and between a proposed project and its alternative primarily because of the length of pipeline routes and the size (number of wells) of each targeted oil field.

The Amoco CO_2 Projects would positively affect the development of oil resources and the economy of the project areas. The major adverse impacts of all projects would include land surface disturbance resulting in vegetation cover loss and, consequently, loss of wildlife and livestock *forage* and an increased potential for erosion. Wildlife will also be disturbed (during non-critical times) along the pipeline route and by wellfield and plant activities. Short-term degradation of water quality would occur at pipeline stream crossings. Minor air quality degradation is expected from *fugitive dust* and construction equipment emissions along the rights-of-way and in wellfields. Construction-related vehicles would increase traffic and are likely to cause accelerated deterioration of some roadways.

Both long- and short-term impacts to recreation, wilderness areas and visual resources can be expected due to noise of construction and visibil-

Table 2-10. **Summary Comparison of Alternatives and Impacts - CO2 Supply.**
(For a comparison of the Proposed Action and its alternative, compare columns headed with the same Roman numeral).

		I	II	III	I	II	III
		Fontenelle			Exxon Alternative CO2 Supply		
Resource Element	No Action	Plant/ Field	Trunk Pipeline	Total	Plant/ Field	Feed Gas Trunkline	Total
Pipeline length (approximate miles)							
Main (Trunk or Spur) Pipeline	0	--	24	24	--	38	38
Production/Injection Pipelines	0	30(a)	--	30	60(a)	--	60
Total miles of construction required	0			54			98
SOCIOECONOMICS							
Population increase	0	280			5397		
Increase over county baseline		<1%					
Significant local government revenue increase - construction (thousands)	0	1,100					
Barrels of oil and gas recovered (millions)	0						
SOILS AND VEGETATION							
Acres of soils and vegetation disturbed during construction (1 year) and short-term vegetation impacts (2 - 5 years)	0	263	218	481	737	346	1083
Acres of soils occupied by surface facilities	0	250	< 1	250	571	<1	571
Approximate miles of steep terrain affected on main (trunk or spur) pipeline	0		0.1			--	
Approximate miles of sensitive soils affected on main (trunk or spur) pipeline	0		4.2			--	
Sensitive plants in the project area			Astragalus jejunus				
AGRICULTURE							
Forage loss (AUMs/yr) short term	0	28(a)	15	43	88(b)	42	130
Forage loss (AUMs/yr) for project life	0	21	1	22	69	<1	70

Table 2-10. Continued.

Resource Element	No Action	Fontenelle Plant/ Field (I)	Fontenelle Trunk Pipeline (II)	Fontenelle Total (III)	Exxon Alternative CO2 Supply Plant/ Field (I)	Exxon Alternative CO2 Supply Feed Gas Trunkline (II)	Exxon Alternative CO2 Supply Total (III)
Cropland disturbed for 1 year (acres)	0	0	0	0		<77	77
Prime farmland in cultivation (acres) disturbed for 1 year	0	0	0	0	--	--	--
WATER RESOURCES							
Perennial stream crossings	0	0	2	2	0	4	4
WILDLIFE							
Crucial deer and antelope winter range affected (acres) (c)	0		50			248	
Crucial deer winter range (acres) (c)	0		0			0	
Crucial antelope winter range (acres) (c)	0		0			0	
Crucial elk winter range (acres) (c)	0		0			50	
Crucial moose winter range (acres) (c)	0		59			27	
Elk calving area (c)	0		0			0	
Sage grouse breeding/nesting habitat (acres)	0	40	20		9(d)	32	
Raptor nests/winter concentration areas	0	6	1		6	0	
Prairie dog colonies	0	0	0		1	9	
Whooping crane (acres)						27	
AIR QUALITY							
Fugitive dust from construction (tons) (e)	0	240	192	432	480	304	784
Plant emissions	Existing conditions will stay the same; will not have the opportunity to reduce SO4 and H2S emissions	<100 tons/year (f)			>7000 tons/year		
Total reduced		<200 lbs/year			4,153 tons/year		
Sulfer emitted							

Table 2-10. Continued.

Resource Element	No Action	Fontenelle I: Plant/Field	Fontenelle II: Trunk Pipeline	Fontenelle III: Total	Exxon Alternative CO2 Supply I: Plant/Field	Exxon Alternative CO2 Supply II: Feed Gas Trunkline	Exxon Alternative CO2 Supply III: Total
CULTURAL RESOURCES							
Surveys complete		Class I	Class I		Class I	Class I	
MINERALS/PALEONTOLOGICAL RESOURCES							
Oil precluded from recovery	200 million barrels		0				
Low paleontological sensitivity (miles)			7				
Moderate paleontological sensitivity (miles)			0				
High paleontological sensitivity (miles)			17				
VISUAL RESOURCES							
Miles of Class I or II areas	0		9 (g)	9	0	0	0
RECREATION RESOURCES							
Short-term impact to fishing streams	None		Class 1			Class 1	
Historic trails crossed	0		1				
Increase in use of recreation areas or facilities	0		10%		13%		
WILDERNESS							
WSAs within 5 miles						Lake Mtn.	
TRANSPORTATION							
Reduction in level of service (h)	None		Yes			Yes	
Accelerated roadway deterioration			SH 372			SH 240 SH 372	

Table 2-10. Continued.

Resource Element	No Action	Fontenelle Plant/ Field (I)	Fontenelle Trunk Pipeline (II)	Fontenelle Total (III)	Exxon Alternative CO2 Supply Plant/ Field (I)	Exxon Alternative CO2 Supply Feed Gas Trunkline (II)	Exxon Alternative CO2 Supply Total (III)
LAND USE PLANS, CONTROLS AND CONSTRAINTS							
In planned pipeline corridor	Would not cause any land use conflicts	Yes/No (i)				yes	
HEALTH AND SAFETY							
Sour gas wells	0	10			20		
Predicted ruptures; sour gas pipelines (j)	0		0.43		.78		
Predicted ruptures; non-sour gas pipelines (j)	0		0				

a = Assumes 3 miles of pipeline for each well to be developed in field, Fontenelle proposes 10 wells, Exxon Alternative CO2 supply 20 wells.
b = Includes disturbance for replacement of production and injection pipelines in wellfield.
c = Habitat disturbance within Wellfield is dependent on location of construction activities which is presently not known. See Table 3-24 for acres of big game range in Wellfield and acres of proposed disturbance.
d = Breeding/nesting areas known in field.
e = Based on 8 tons per mile of pipeline construction.
f = Gas plants will reduce present emisions of H2S and SO4.
g = Part of the Raptor field is Class II but wells should not be sited in this area.
h = Level of service reduction is short-term; not based on annual average.
i = Field is in Fontenelle recreation area and Green River.
j = Breeding/nesting areas known in the field.

Table 2-11. **Summary Comparison of Alternatives and Impacts - Enhanced Oil Recovery Projects**
(For a comparison of Proposed Actions and their Alternatives, compare columns with the same Roman numeral.)

								IV	IV								V	V
	Elk Basin				Beaver Creek			Total of Elk Basin and Beaver Creek	Beaver Creek Alternative	Little Buffalo Basin			Salt Creek				Salt Creek	Frontier/Casper Alternative
Resource Element	Plant/ Field	Trunk Pipeline	Bairoil/Dakota Milepost 112-185	Total	Plant/ Field	Trunk Pipeline	Total	Trunk Pipelines	Trunk Pipeline	Plant/ Field	Spur Pipeline	Total	Plant/ Field	Spur Pipeline	Bairoil/Dakota Milepost 185-221	Total	Pipelines Only	Pipeline
Pipeline length (approximate miles)																		
Main (Trunk or Spur) Pipeline		178	73	251		44	44	295	231 (a)		36	36		9	36	45	36	64
Production/Injection Pipelines	75			75	28		28			90		90	195			195		
Total miles of construction required				326	28	44	72					126				240		
SOCIOECONOMICS																		
Population increase	241				217					202			272					
Increase over county baseline	1%				< 1%					<2%			<1%					
Significant local government revenue increase - construction (thousands)	1,250				930					48			4520					
Barrels of oil and gas recovered (millions)	65				30					15			50					
SOILS AND VEGETATION																		
Acres of soils and vegetation disturbed during construction (1 year) and short-term vegetation impacts (2 - 5 years)	683	1637	665	2985	228	404	632	2706	2109	819	326	1145	1775	85	328	2188	413	578
Acres of soils occupied by surface facilities	40	< 2			40	< 1	40			40	< 1	41	40	< 1	< 1	41	< 1	< 1
Approximate miles of steep terrain affected on main (trunk or spur) pipeline		12	8	17		3	3	23	2.2(b)		3			1	7	8	8	5
Approximate miles of sensitive soils affected on main (trunk or spur) pipeline		148	8	156		42	42	198	21		23	23		8	7	15	15	54
Sensitive plants in the project area	Artemisia porteri Cryptantha subcapitata Cleome multicaulis				Artemisia porteri Antennaria arcuata Physaria saximontana					Cymopterus evertii								
AGRICULTURE																		
Forage loss (AUMs/yr) short term	42(c)	124	64	230	24(c)	45	69	233	151	128(c)	24	152	227(c)	8	33	268	41	89
Forage loss (AUMs/yr) for project life	< 3	< 1	< 1	< 5	< 5	< 1	6	< 1	< 1	7	< 1	8	5	< 1	< 1	6	< 1	< 1

Table 2-11. Continued.

Resource Element	Elk Basin Plant/ Field	Elk Basin Trunk Pipeline	Elk Basin Bairoil/Dakota Milepost 112-185	Elk Basin Total	Beaver Creek Plant/ Field	Beaver Creek Trunk Pipeline	Beaver Creek Total	IV Total of Elk Basin and Beaver Creek Trunk Pipelines	IV Beaver Creek Alternative Trunk Pipeline	Little Buffalo Basin Plant/ Field	Little Buffalo Basin Spur Pipeline	Little Buffalo Basin Total	Salt Creek Plant/ Field	Salt Creek Spur Pipeline	Salt Creek Bairoil/Dakota Milepost 185-221	Salt Creek Totals	V Salt Creek Pipelines Only	V Frontier/Casper Alternative Pipeline
Cropland disturbed for 1 year (acres)	0	89	4	93	0	0	0	93	75	0	26	26	0	0	0	0	0	4.6
Prime farmland in cultivation (acres) disturbed for 1 year	0	38		38	0	0	0	38	38	0	20	20	0	0	0	0	0	0
WATER RESOURCES																		
Perennial stream crossings		13	7	20		3	3	16	16		3	3		0	1	1	1	1/0
WILDLIFE																		
Crucial deer and antelope winter range affected (acres) (d)		155	288					443	170		0			0	0		0	0/0
Crucial deer winter range (acres) (d)		66	0			0		66	56		0			0	0		0	0/0
Crucial antelope winter range (acres) (d)		226	0			174		400	336		36			0	120		120	0/0
Crucial elk winter range (acres) (d)		0	60			0		60	0		0			0	0		0	0/0
Crucial moose winter range (acres) (d)		0	0			0		0	0		0			0	0		0	0/0
Elk calving area (d)		0	12			0		12	0		0			0	0		0	0/0
Sage grouse breeding/nesting habitat (acres)	3(e)	264	120		0	32		416	265	6(e)	175		0	0	24		24	78/0
Raptor nests/winter concentration areas	0	18	4		0	0		22	11	0	1		0	1	1		2	0/0
Prairie dog colonies	2	4	0			0		4	4	4	2		0	1	0		1	5/Unknown
Whooping crane (acres)																		
AIR QUALITY																		
Fugitive dust from construction (tons) (f)	600	1424	584	2608	224	352	576	2360	1,848	720	288	1008	1,560	72	288	1920	288	512
Plant emissions	<100 tons/year (g)		N/A		<100 tons/year (g)					<100 tons/year (g)			<100 tons/year (g)					
Total reduced	<200 lbs/year		N/A		<200 lbs/year					<200 tons/year			<200 tons/year					N/A
Sulfer emitted																		

Table 2-11. Continued.

Resource Element	Elk Basin Plant/ Field	Elk Basin Trunk Pipeline	Elk Basin Bairoil/Dakota Milepost 112-185	Elk Basin Total	Beaver Creek Plant/ Field	Beaver Creek Trunk Pipeline	Beaver Creek Total	IV Total of Elk Basin and Beaver Creek Trunk Pipelines	IV Beaver Creek Alternative Trunk Pipeline	Little Buffalo Basin Plant/ Field	Little Buffalo Basin Spur Pipeline	Little Buffalo Basin Total	Salt Creek Plant/ Field	Salt Creek Spur Pipeline	Salt Creek Bairoil/Dakota Milepost 185-221	Salt Creek Totals	V Salt Creek Pipelines Only	V Frontier/Casper Alternative Pipeline
CULTURAL RESOURCES																		
Surveys complete		Class III	Class 1		Class	Class I		Class I or III	Class I incomplete	Class	Class I		Class	Class I			Class 1	Class III/Class 1 /incomplete
MINERALS/PALEONTOLOGICAL RESOURCES																		
Oil precluded from recovery	0				0					0			0					
Low paleontological sensitivity (miles)		37				4		41	34		3			0				6
Moderate paleontological sensitivity (miles)		29				3		32	25		4			9				18
High paleontological sensitivity (miles)		112				38		150	128		29			0				40
VISUAL RESOURCES																		
Miles of Class I or II areas	0	1	15	16	0	5	5	21	6	0	0		0	0	0	0	0	0
RECREATION RESOURCES																		
Short-term impact to fishing streams		Class 3&4	Class 4			Class 3		Class 3&4	Class 3&4		Class 4			None				Class 4
Historic trails crossed		3				1			2		0			0				0
Increase in use of recreation areas or facilities	<10%				<10%					<10%			<10%					
WILDERNESS																		
WSAs within 5 miles		Sheep Mountain Red Butte Cedar Mountain	Sweetwater Rocks					Sheep Mountain Red Butte Cedar Mountain Sweetwater Rocks	Sheep Mountain Red Butte Cedar Mountain									
TRANSPORTATION																		
Reduction in level of service (h)	Yes				Yes			Yes	Yes		Yes			Yes			Yes	Yes / Yes
Accelerated roadway deterioration	SH 295				SH 135				SH 135 SH 136		US 20 SH 120			SH 387			SH 387	SH 372 / SH 259

Table 2-11. Continued.

Resource Element	Elk Basin Plant/ Field	Elk Basin Trunk Pipeline	Elk Basin Bairoil/Dakota Milepost 112-185	Elk Basin Total	Beaver Creek Plant/ Field	Beaver Creek Trunk Pipeline	Beaver Creek Total	IV Total of Elk Basin and Beaver Creek Trunk Pipelines	IV Beaver Creek Alternative Trunk Pipeline	Little Buffalo Basin Plant/ Field	Little Buffalo Basin Spur Pipeline	Little Buffalo Basin Total	Salt Creek Plant/ Field	Salt Creek Spur Pipeline	Salt Creek Bairoil/Dakota Milepost 185-221	Salt Creek Totals	V Salt Creek Pipelines Only	V Frontier/Casper Alternative Pipeline
LAND USE PLANS, CONTROLS AND CONSTRAINTS																		
In planned pipeline corridor		Yes	No (i)			Yes (j)								No				Yes
HEALTH AND SAFETY																		
Sour gas wells					0					0			0		0			0
Predicted ruptures; sour gas pipelines (k)	.60	0			.20					.72	0		1.56	0				
Predicted ruptures; non-sour gas pipelines (k)	.36	1.42	.60		.22	.35			1.49	.52	.28		1.46	.07	.87			.51

a = Mileage includes 55 miles of the Beaver Creek Alternative section, 44 miles of Beaver Creek Truck Pipeline and 132 miles of the Elk Basin Trunk Pipeline.
b = Estimate based on soil survey of approximately half of the area.
c = Includes disturbance for replacement of production and injection pipelines in wellfield.
d = Habitat disturbance within Wellfield is dependent on location of construction activities which is presently not known. See Table 3-24 for acres of big game range in Wellfield and acres of proposed disturbance.
e = Breeding/nesting areas known in field.
f = Based on 8 tons per mile of pipeline construction.
g = Gas plants will reduce present emisions of H2S and SO4.
h = Level of service reduction is short-term; not based on annual average.
i = Segment would cross Oregon - Mormon trail and pass through Sweetwater Rocks.
j = Would cross the Oregon - Mormon trail.
k = Based on one rupture per 5,000 mile-years and 40-year project life.

ity of the reclaimed pipeline alignment, but these impacts would be minor because of the location of all facilities adjacent to similar disturbances. Similar impacts to cultural resources (e.g., *historic* trails) would result from construction of all projects. Until Class III cultural surveys are conducted for all alignments, the extent of impact and required mitigation cannot be determined. Long-term impacts to cultural sites should be minor after mitigation measures are implemented.

In order to simplify the comparison of proposed projects and their alternatives, the first line in Tables 2-10 and 2-11 contain a Roman numeral to indicate which columns of the table are comparable. For example, Roman numeral I indicates that the "Fontenelle Plant/Field" data column should be compared to the "Exxon Plant/Field" data column. Similarly (Roman numeral V) the column labeled "Salt Creek/Pipelines Only," which is a total of the Salt Creek Spur Pipeline and the Bairoil/Dakota Pipeline (mileposts 185 - 221) should be compared to the "Frontier/Casper Alternative Pipeline" data.

These comparisons indicate that the production of CO_2 from the Raptor Field with processing in the Fontenelle Gas Processing Plant would disturb less than half the land (both in acreage and forage value) and only about 20 percent of the crucial deer and antelope winter range compared to using CO_2 from Phase II of Exxon's LaBarge Project. The Fontenelle Project is likely to disturb more moose and sage grouse habitat. Fugitive dust and plant emissions are expected to be much higher from the Exxon facility. Any comparison of the Fontenelle Project to Exxon's Phase II LaBarge project must, however, recognize that CO_2 production would not be the only product of the La Barge Project's Shute Creek Plant.

Comparison of the Elk Basin and Beaver Creek Trunk pipelines to the Beaver Creek Alternative route (column IV), indicates that the Beaver Creek Alternative alignment is about 64 miles shorter, resulting in less soil and vegetation disturbance, less steep terrain affected, less forage lost and less wildlife habitat impacted. The Beaver Creek Alternative route would also avoid the Sweetwater Rocks Wilderness Study Area vicinity.

Comparison of the Salt Creek and Frontier/Casper pipeline alignments (column V) indicates that even with the impacts of the Bairoil/Dakota Pipeline from milepost 185 to 221, the Salt Creek Project would generally have less environmental impact than the Frontier/Casper alignment. If, however, the Beaver Creek alignment is constructed rather than the Elk Basin Project, construction of the Salt Creek Project would require construction of the Bairoil/Dakota Pipeline from milepost 112 rather than only from milepost 185. This additional disturbance (73 miles) would exceed the impacts of the Frontier/Casper alignment.

2.9 BUREAU OF LAND MANAGEMENT'S PREFERRED ALTERNATIVE

The BLM preferred alternative is to grant rights-of-way for the Proposed Actions conditional on minor alignment adjustments that would be addressed in the projects' Plans of Development after site-specific studies are completed. Site studies would include wildlife (raptors, sage grouse and black-footed ferrets), *sensitive plant species* and Class III *cultural resource surveys*. The rights-of-way would be granted only after BLM-approved Plans of Development addressed construction techniques applicable to the specific soils, vegetation and topography of each route.

Under present conditions, the Raptor CO_2 Field with gas sweetening at the proposed Fontenelle gas processing plant is considered the most economical and environmentally sound source of CO_2 available for the enhanced oil recovery projects. The proposed pipeline alignments serving the Elk

Basin, Beaver Creek, Little Buffalo Basin and Salt Creek fields would be, with implementation of standard and project-specific mitigation measures, environmentally acceptable. These routes are desirable because they are adjacent to similar disturbances.

CHAPTER 3
AFFECTED ENVIRONMENT

3.1 INTRODUCTION

Chapter 3 of the *DEIS* describes the affected environment for each of the five proposed projects and alternatives. The affected environment is described as it exists today. In all cases, the affected environment is considered the baseline case (i.e., how the area would be characterized if the Amoco Projects or alternatives were unable to proceed). As such, the affected environment described in this chapter is the same as the impacted environment for the No Action Alternative.

The description of the affected environment is organized by resource. Resource discussions include an introduction to the aspects of the environment that are common to all projects and alternatives and a brief discussion of data sources and methods. This is followed by a description of the environment that could be affected by each proposed project and alternative along the pipeline rights-of-way, at the plant sites and in the wellfields. Since the location of specific project components in the wellfield (e.g., production or injection lines that may be replaced) are not known at this time, the description of the affected environment of the wellfield is more general than the description of either the rights-of-way or plant sites. For pipelines, data were generally evaluated for the proposed and alternative routes and a two-mile *corridor* centered on the pipeline centerlines. For *cultural resources*, the study area for Class I surveys included all sections crossed by a pipeline or within a field. Class III surveys were conducted in a 100-foot-wide corridor centered on the centerline.

Data describing the *Proposed Actions* and alternatives were obtained from a variety of sources. Much of the information was taken from *BLM* resource area files and management plans. Most of the site-specific data were evaluated with the aid of BLM personnel knowledgeable about the resource or the area. Other sources of information include other federal agencies, state agencies and local governments (see Chapter 6). Much of the information describing the alternatives was extracted from EISs for the alternative projects.

Descriptions of the affected environment of the Elk Basin and Salt Creek projects also include a summary discussion of the affected environment of associated pipelines. These pipelines include pending sections of the Bairoil/Dakota CO_2 Pipeline that would have to be built from its current terminus (Bairoil/Dakota milepost 112) to the Amoco Proposed Action Elk Basin and Salt Creek pipeline origin stations (see Figure 1-1). The associated pipeline for the Elk Basin Project would be 73 miles long (Bairoil/Dakota mileposts 112 to 185) and 36 miles long (Bairoil/Dakota mileposts 185 to 221) for the Salt Creek Project. Data for these discussions are summarized from the Bairoil /Dakota EIS (BLM, 1985a).

This chapter continues with a description of the affected environment of the Beaver Creek Alternative and Frontier/Casper Alternative pipeline alignments. The affected environment of the Beaver Creek Alternative alignment includes the environment of the Beaver Creek Trunk Pipeline (44 miles), the Beaver Creek Alternative Section (55 miles) and the Elk Basin Trunk Pipeline from milepost 132 to the plant site (132 miles). In order to avoid repetition, only the new Beaver Creek Alternative Section is

described in detail. Data describing other portions of this alternative alignment are summarized and the reader is referred to the discussions of the Beaver Creek and Elk Basin projects for details.

The affected environment of the Frontier/Casper Alternative alignment includes the Frontier Section (24 miles) and the Casper Section (40 miles). This chapter does not describe the environment of the existing Frontier Pipeline route or the Bairoil/Dakota Pipeline to milepost 112 since these pipelines have already been constructed.

The last alternative considered in detail in the DEIS is the Exxon Alternative CO_2 Supply. The affected environment for this alternative includes the Riley Ridge wellfield and the area affected by Phase II of the Shute Creek Gas Plant. Data for this discussion are summarized from the Riley Ridge Natural Gas Project EIS (BLM, 1983c), Exxon's LaBarge Project Phase II Industrial Siting Application (Exxon, 1985) and a Phase I critique session summary (Exxon, 1987).

Location maps are provided in Appendix 4 to assist the reader in understanding the projects. Every attempt has been made to accurately reflect the alignments, but considering the scale of these maps (i.e., 1:100,000), the routes should be considered schematic. If rights-of-way are to be granted, site surveys will be conducted and the final alignments mapped at 1:24,000 scale will be included in the PODs.

3.2 SOCIOECONOMIC CONDITIONS

3.2.1 Introduction

For each of the five projects addressed by this DEIS, certain local government jurisdictions have been designated as being within the primary area of site influence for project-related socioeconomic effects. These jurisdictions primarily encompass communities that would be served by Amoco's proposed busing program, which is described in Chapter 2. Destination communities for the busing program were selected based on the following criteria: size; proximity to the plant and wellfield work sites; availability of housing; adequacy of public facilities and services; and compatibility of the project with other existing economic activities. Where possible, Amoco would attempt to direct population effects to jurisdictions that would receive direct tax revenues (in the form of sales and use tax or production-based ad valorem tax).

Also identified are certain local government jurisdictions near the construction work sites, but not included in the primary area of site influence, because they would not be served by Amoco's busing program. Although these communities may experience minor temporary growth from the projects, the majority of the project-generated population growth is anticipated to be within the primary area of site influence. Detailed economic, population, housing and local government facility, service and fiscal information about nearby communities not in the area of site influence is presented in the Socioeconomic Technical Report. Small communities near the pipeline route have not been discussed because the nature of the pipeline *workforce* (organized in spreads) coupled with its rapid pace will generate no measurable socioeconomic *impacts* to these communities.

Information concerning the capacity and condition of public facilities and services was obtained from interviews with local government officials and service administrators. Revenue and expenditure data for counties and municipalities were obtained from A Study of Revenues and Expenditures prepared for the Wyoming Joint Legislative-Executive Review Committee (Ferrari, Sommers and Washburn, 1988).

Fiscal and enrollment data for school districts were obtained from the Wyoming State Department of Education Statistical Report Series. School building capacity and condition information was obtained from local school district administrators.

3.2.2 Fontenelle Project

Jurisdictions Within the Primary Area of Site Influence

- Sweetwater County;
- Sweetwater School District #2;
- City of Green River.

The Sweetwater County community of Green River would be the destination community for Amoco's proposed busing program.

Local Economy. Table 3-1 displays recent Sweetwater County employment and earning trends. The economy of Sweetwater County is based primarily on *trona* and coal mining, the oil and gas industry, electric power generation and on Rock Springs' position as a regional trade center.

According to the Wyoming Department of Administration and Fiscal Control (*DAFC*), Sweetwater County has experienced recent declines in employment, decreasing from 25,893 total employees in 1981 to an estimated 20,056 in 1988, a decline of 22 percent. Mining sector employment decreased 46 percent during this period, from 6,856 in 1981 to an estimated 3,707 in 1988. Construction sector employment decreased 60 percent, from 3,859 in 1981 to 1,534 in 1988. During this period gross earnings (adjusted to 1986 dollars) declined from $679,389,000 in 1981 to an estimated $467,171,000 in 1988, a decrease of 31 percent (DAFC, 1986; DAFC, 1988).

This decline in employment and earnings stems from several factors, including the completion of construction of two major industrial processing plants (the Chevron Phosphate Plant and the Exxon LaBarge Natural Gas Processing Plant); completion of several other construction projects (the Jim Bridger Power Plant retrofit and the expansion of Western Wyoming College); the decline in the market for trona; and the recent precipitous drop in oil prices.

Population. Table 3-2 lists recent population trends for Sweetwater County and the City of Green River. Driven by declining employment, Sweetwater County population decreased from 45,068 in the peak year of 1982 to 42,007 in 1988, a loss of 7 percent according to the Wyoming Department of Administration and Fiscal Control. However, local estimates identify 1985 as the peak year, with county population at 47,415, decreasing to 46,977 in 1988, a drop of less than 1 percent (Sweetwater County Planning Department, 1987). Green River has lost 742 people since 1981, decreasing from 15,540 to an estimated 14,798 or about 5 percent in the peak year of 1985 (Sweetwater County Planning Department, 1987).

Housing. Current housing estimates for the City of Green River include 3,248 single-family homes, 863 multi-unit structures and 827 mobile homes, for a total of 4,938 units (Hatch, 1987; Bureau of Census, 1982).

According to a December 1987 housing availability survey conducted by Planning Information Corporation, 137 houses and 10 mobile homes were for sale; 8 houses, 67 apartments, 2 mobile homes and an unknown number of mobile home pads were for rent in Green River (Table 3-3).

Additionally, of the 185 motel rooms in the city, an average of 76 are available in summer and 127 are available in winter. Of the 55 *recreational vehicle* pads in the city, 14 are available in the summer and 18 are available in the winter.

Local Government Facilities and Services. In general, public facili-

Table 3-1. Recent Employment and Earnings Trends in Project Counties. (a)

	1980	1981	1982	1983	1984	1985	1986	1987	1988
SWEETWATER COUNTY									
Employment (Number of Employees)									
Agriculture	284	272	287	301	300	301	302	303	293
Mining (b)	6,392	6,856	6,633	5,277	4,783	4,527	3,896	3,677	3,707
Construction	3,169	3,859	2,820	1,569	1,643	2,390	2,939	1,534	1,534
Manufacturing	493	537	507	463	427	510	550	518	501
TCPU (c)	2,178	2,438	2,387	2,229	2,357	2,487	2,411	2,280	2,330
Wholesale Trade	770	804	870	678	649	716	724	728	688
Retail Trade	3,647	3,908	3,992	3,589	3,492	3,690	3,581	3,336	3,386
FIRE (d)	573	613	678	665	660	707	695	680	676
Services	3,161	3,301	3,225	2,832	2,930	3,165	3,138	3,104	3,042
Government	3,082	3,305	3,505	3,759	3,810	4,028	3,912	3,929	3,899
TOTAL (e)	23,749	25,893	24,904	21,362	21,051	22,522	22,148	20,089	20,056
Gross Earnings (86$) (f)	629,038	679,389	631,998	529,817	509,169	524,612	515,901	467,940	467,171
WASHAKIE COUNTY									
Employment (Number of Employees)									
Agriculture	630	608	628	628	619	620	621	622	624
Mining (b)	381	449	357	293	373	292	196	146	176
Construction	355	351	379	389	366	342	301	282	292
Manufacturing	518	519	512	491	496	515	508	464	454
TCPU (c)	366	365	322	290	322	328	316	305	295
Wholesale Trade	198	236	210	195	196	197	188	185	175
Retail Trade	701	723	716	691	728	734	702	689	679
FIRE (d)	252	268	260	260	270	275	266	263	267
Services	965	997	1,026	1,032	1,021	995	917	887	897
Government	840	830	829	870	924	943	914	912	914
TOTAL (e)	5,206	5,346	5,239	5,139	5,315	5,242	4,929	4,755	4,773
Gross Earnings (86$) (f)	101,594	97,654	87,689	86,209	89,747	88,514	83,229	80,291	80,595
FREMONT COUNTY									
Employment (Number of Employees)									
Agriculture	1,293	1,284	1,344	1,282	1,266	1,263	1,261	1,262	1,274
Mining (b)	3,950	3,222	2,561	2,122	1,503	1,146	767	693	743
Construction	1,420	1,409	1,329	1,385	1,366	1,232	1,073	1,014	984
Manufacturing	697	632	597	654	645	644	631	662	651
TCPU (c)	840	940	961	877	867	889	893	858	868
Wholesale Trade	425	540	503	578	543	506	459	405	415
Retail Trade	3,157	3,069	2,998	2,927	2,933	2,904	2,819	2,773	2,803
FIRE (d)	874	741	741	744	795	759	708	705	715
Services	3,798	3,887	4,095	3,936	3,958	3,932	3,828	3,757	3,787
Government	3,391	3,460	3,425	3,765	3,807	3,847	3,812	3,811	3,811
TOTAL (e)	19,845	19,184	18,554	18,270	17,683	17,122	16,251	15,940	16,051
Gross Earnings (86$) (f)	396,306	360,024	317,599	296,180	276,219	240,019	227,809	223,450	225,006

Table 3-1. Continued.

	1980	1981	1982	1983	1984	1985	1986	1987	1988
PARK COUNTY									
Employment (Number of Employees)									
Agriculture	1,257	1,212	1,252	1,239	1,219	1,202	1,188	1,186	1,200
Mining (b)	1,185	1,426	1,257	1,127	1,154	1,060	969	919	969
Construction	995	1,043	1,100	1,174	1,269	1,161	1,055	1,030	1,050
Manufacturing	875	883	865	723	537	481	426	447	467
TCPU (c)	574	578	589	609	618	597	578	561	581
Wholesale Trade	372	391	389	416	477	450	423	383	403
Retail Trade	2,874	2,979	2,219	2,206	2,176	2,179	2,187	2,082	2,132
FIRE (d)	498	551	581	602	637	631	627	613	623
Services	2,234	2,307	3,386	3,328	3,409	3,219	3,035	3,007	3,057
Government	2,253	2,278	2,406	2,388	2,571	2,588	2,609	2,597	2,588
TOTAL (e)	13,117	13,648	14,044	13,812	14,067	13,569	13,097	12,825	13,070
Gross Earnings (86$) (f)	219,057	221,284	210,477	201,900	206,388	199,082	192,157	188,166	191,761
NATRONA COUNTY									
Employment (Number of Employees)									
Agriculture	730	750	796	781	788	772	755	722	770
Mining (b)	7,923	9,589	8,268	6,440	6,771	5,476	3,862	3,204	3,254
Construction	4,206	3,981	3,742	3,070	3,082	2,860	2,471	2,341	2,311
Manufacturing	1,937	2,173	1,961	1,425	1,501	1,564	1,536	1,465	1,495
TCPU (c)	3,047	3,162	3,006	2,565	2,417	2,329	2,106	1,998	1,988
Wholesale Trade	4,240	4,574	4,523	3,624	3,565	3,353	2,946	2,504	2,554
Retail Trade	7,094	7,132	7,173	6,790	6,856	6,944	6,628	6,368	6,418
FIRE (d)	2,941	2,981	3,019	2,984	2,989	3,025	2,884	2,842	2,872
Services	8,444	9,112	9,009	8,559	8,887	8,810	8,220	7,795	7,845
Government	5,804	5,896	6,165	6,266	6,188	6,186	6,184	6,121	6,141
TOTAL (e)	46,366	49,350	47,662	42,504	43,044	41,318	37,592	35,410	35,648
Gross Earnings (86$) (f)	1,117,122	1,144,361	1,033,146	879,283	855,000	736,523	670,105	631,209	635,452

a - Source: Wyoming Department of Administration and Fiscal Control, Income and Employment 1986; print-out of population and employment, 1988; Planning Information Corporation, 1988.
b - Mining includes the oil and gas industry.
c - TCPU is Transportation, Communication and Public Utilities.
d - FIRE is Finance, Insurance and Real Estate.
e - Sum of columns may not equal totals due to rounding in data sources (DAFC).
f - All dollars expressed in thousands.

Table 3-2. Recent Population Trends, Sweetwater County and City of Green River, Wyoming.

	1980	1981	1982	1983	1984	1985	1986	1987	1988
Sweetwater County - Local Est. (a,b)	41,723	N/A	N/A	44,739	43,730	47,415	43,583	46,736	46,977
Green River (c)	12,807	N/A	N/A	13,672	13,842	15,540	13,780	14,722	14,798
Sweetwater County - DAFC Est. (d,e)	41,723	45,008	45,068	41,952	40,901	43,730	44,467	41,946	42,007
Green River (f)	12,807	14,310	15,290	12,820	12,947	14,332	14,060	13,213	13,377

a = Source: 1983-87 population estimates for Green River and Rock Springs from the Sweetwater County Planning Department (Sweetwater County, Quarterly No. 16, 1988); modified in personal communication with Dennis Watt, Director, Sweetwater County Planning Department, January 26, 1988.

b = Source: 1988 estimates from 1986 - 1995 Sweetwater County Population Projections (Sweetwater County Planning Department, 1987c).

c = Source: 1981-85 estimates for Green River from Exxon LaBarge Project Socioeconomic Monitoring Report, Second Quarter 1986, August 1986.

d = Source: 1980-1998 county estimates and projections from Wyoming Department of Administration and Fiscal Control, (DAFC) Statistics Division, 1988.

e = Note: Except for 1986, DAFC estimates and projections for Sweetwater County are lower than those prepared by the county in January 1987. Dennis Watt, Sweetwater County Planner, believes that actual county population would be somewhere between the two estimates, or about 43,000 or 44,000 in 1988 (Watt, 1988).

f = Source: 1988 estimates for Green River based on projections by Sweetwater County for cities, multiplied by the ratio of Sweetwater County local projections to DAFC projections for the county.

Table 3-3. December 1987 Housing Availability Summary. (a)

	Fontenelle	Elk Basin	Beaver Creek	Little Buffalo Basin		Salt Creek			
	Green River (b, c, d)	Powell (e)	Riverton (f, g)	Worland	Meeteetse (h, i)	Casper (j)	Midwest (k)	Edgerton (l)	Total
STANDARD HOUSING UNITS FOR RENT									
Apartments	67	15	25	25	0	1,730	0	1	1,731
Mobile Homes	2	3	30	12	0	200	0	9	209
Houses	8	17	20	35	15	76	5	6	87
TOTAL STANDARD HOUSING UNITS FOR RENT	77	35	75	72	25	2,006	5	16	2,027
TEMPORARY HOUSING									
RV Sites: Avg. Surplus at Peak	14	0	0	15	0-14	58	0	0	58
Motel Rooms: Min. Surplus, Peak	76	32	125	0	0-33	980	0	0	980
TOTAL TEMPORARY HOUSING	90	32	125	15	2	1,038	0	0	1,038
TOTAL RENTALS AVAILABLE AT PEAK	167	67	200	87	27	3,044	5	16	3,065
VACANT MOBILE HOME PADS	6	40	355	22	0	750	6	44	800

a - Source: Planning Information Corporation surve, November 1987 - January 1988.
b - Source: City of Green River, November 1987.
c - Source: Wyoming Travel Commission, Wyoming Vacation Guide.
d - Source: City of Green River, Chamber of Commerce.
e - Source: Powell Tribune, November 5, 1987.
f - Source: Apartment and mobile home estimates are conservative, based on realtor's estimate of 25-50 vacant apartments and statement that vacant mobile homes outnumber vacant apartments (Ratliff, 1988).
g - Source: Motel rooms based on 13 motels with 472 rooms, applying area occupancy rates provided by Riverton Chamber of Commerce (Hawley, 1987).
h - Source: Meeteetse Town Clerk and Mayor (Yetter, 1988; Taylor, 1987).
i - Source: Coldwell-Banker/Antlers Realty (Bole, 1988).
j - Source: Casper Board of Realtors; Casper Star Tribune. 1/15/88; and Casper Motel and Hotel Owners Association.
k - Source: Midwest Mayor and Town Clerk.
l - Source: Edgerton Mayor and Town Clerk.

ties provided by Sweetwater County and the City of Green River are adequate in capacity and condition to serve current population levels as well as additional growth. The one exception is the Sweetwater County Jail which does not currently meet federal standards (Paine, 1987). Both Sweetwater County and the City of Green River have recently reduced staff levels to respond to diminished revenues.

Sweetwater County School District #2 serves the City of Green River and surrounding area. The district currently operates eight elementary schools, two middle schools and one high school. Total district 1987-88 fall enrollment was 3,889 students. There is capacity for additional students at all grade levels; however, the high school has reached its optimum capacity (Zachness, et al, 1987).

Local Government Revenues and Expenditures. Sweetwater County revenues totaled $20,828,685 in Fiscal Year (*FY*) 1986-87, a 6 percent decrease from the previous year. Of the total, 6 percent ($1,146,113) was obtained from the state sales and use tax, 5 percent ($1,026,329) was derived from the local option sales and use tax and 57 percent ($11,773,617) was obtained from property tax. The remaining 32 percent is derived from fees, fines, interest and miscellaneous revenue. Sweetwater County expenditures totaled $16,992,336 in FY 1986-87.

City of Green River revenues totaled $7,442,292 in FY 1986-87, a 14 percent decrease from the previous year. Of this total, 23 percent ($1,703,529) was obtained from the state sales and use tax, 23 percent ($1,684,935) was obtained from the local option sales and use tax and 8 percent ($592,068) was derived from sewer system user fees. The remaining 46 percent was derived from fees, fines, licenses, interest and miscellaneous revenue. Green River expenditures totaled $8,779,010 in FY 1986-87.

Sweetwater County School District #2 revenues totaled $17,801,978 in FY 1986-87, a 7 percent decrease over the previous year. Of the total revenues, 73 percent were derived from local and county sources (primarily property taxes) and 25 percent were obtained from state sources (primarily the state foundation program). Sweetwater School District #2 expenditures for FY 1986-87 totaled $18,067,638.

Jurisdictions Outside the Primary Area of Site Influence

The following local government jurisdictions are near the Fontenelle Project area, but are not included in the primary area of site influence because they will not be served by Amoco's busing program. Consequently, these local government jurisdictions are anticipated to receive no measurable socioeconomic impacts from the Fontenelle project.

- City of Rock Springs;
- Town of Granger;
- Lincoln County;
- Lincoln School District #2;
- City Of Kemmerer;
- Town of Diamondville;
- Town of Opal.

3.2.3 Elk Basin Project

Jurisdictions Within the Primary Area of Site Influence

- Park County;
- City of Powell;
- Park School District #1.

The Park County community of Powell would be the destination community for Amoco's proposed busing program.

Local Economy. Table 3-1 lists recent Park County employment and earnings trends. Park County's economy is based primarily on tourism, government employment, the oil industry and agriculture.

Total Park County employment declined from 13,648 in 1981 to an estimated 13,070 in 1988, or 4 percent. Mining sector employment decreased 32 percent during this period from 1,426 in 1981 to an estimated 969 in 1988. Construction sector employment experienced gains during 1983 and 1984, but ended the period at 1,050, 17 percent less than the 1984 peak. Retail trade employment fell 28 percent, from 2,979 in 1981 to 2,132 in 1988. Conversely, service sector employment increased 33 percent, from 2,307 in 1981 to 3,057 in 1988. Gross earnings (adjusted to constant 1986 dollars) decreased from $221,284,000 in 1981 to $191,761,000 in 1988, a decrease of 13 percent (DAFC, 1986; DAFC, 1988).

Population. Table 3-4 presents recent population trends in Park County and the City of Powell. Park County population grew from 22,169 in 1981 to 22,232 in 1988, or about 5 percent over the seven years. During roughly the same period, the City of Powell grew 13 percent, from 5,310 in 1980 to 5,999 in 1988.

Housing. The most recent housing inventory for Powell is the 1980 census. At that time, the City of Powell had a total of 2,001 housing units, of which 1,885 were year-round occupied units (Bureau of Census, 1982). A December 1987 housing availability survey by Planning Information Corporation identified 60 homes for sale in the Powell area. Approximately 17 houses, 15 multi-family units and 3 mobile homes were for rent at this time (Table 3-3). Approximately 40 mobile home pads were also available.

Additionally, of the 144 hotel and motel rooms in Powell, an average of 32 rooms are available in the summer and 63 are available in the winter. Of the approximately 75 recreational vehicle spaces in Powell, 25 are in a park and 50 are at the fairground. Recreational vehicle spaces are usually not available during the summer construction period.

Local Government Facilities and Services. In general, public facilities provided by Park County and the City of Powell are adequate in capacity and condition to serve current population levels with some capacity for expansion. One exception is the Park County Jail which has on occasion been required to hold more prisoners than its design capacity. The Park County Sheriff's Office space in Powell is also too small for current needs (Hodge, 1987).

Park County School District #1 serves most of Park County. The Elk Basin Plant would be constructed in this district. The district operates four elementary schools, one junior high school and one high school. Total district fall enrollment for 1987-88 was 1,864 students. The district has capacity for an additional 315 students, using maximum capacities for each school. However, every school in the district has either exceeded optimum capacity for enrollment or is very near optimum capacity (Ribble, 1987).

Local Government Revenues and Expenditures. Park County revenues totaled $8,366,419 in FY 1986-87, a 1 percent increase over the previous year. Of this total, 9 percent ($781,276) was obtained from sales and use tax and 58 percent ($4,814,365) was obtained from property tax revenues. Park County expenditures totaled $7,926,618 in FY 1986-87.

City of Powell revenues totaled $4,564,285 in FY 1986-87, a 6 percent decrease from the previous year. Of this total, 12 percent ($534,947) was obtained from sales and use tax revenues and 43 percent ($1,985,264) was obtained from electrical utility fees. City of Powell expenditures totaled $3,846,246 in FY 1986-87.

Park County School District #1 revenues totaled $8,373,571 in FY 1986-87, a decrease of 4 percent from the previous year. Of that total, 62 percent was derived from local and county sources (primarily property

Table 3-4. Recent Population Trends, Park County and City of Powell, Wyoming.

	1980 (a)	1981	1982	1983 (b)	1984	1985	1986	1987	1988
Park County, WY (c)	21,639	22,169	23,035	23,431	23,940	23,894	23,237	23,055	23,232
Powell (d,e)	5,310	N/A	N/A	5,667	N/A	N/A	6,000	5,953	5,999

a = Source: 1980 U.S. Census data from Wyoming Census Retrieval and Information Service, Report #5, October, 1981.

b = Source: 1983 estimates from Wyoming Department of Administration and Fiscal Control, Research and Statistics Division 1983 Population Estimates prepared by Wyoming Liquor Commission (DAFC, 1983).

c = Source: 1980-1998 county estimates and projections from Wyoming Department of Administration and Fiscal Control, Statistics Division, 1988.

d = Source: 1986 estimate for Powell, "just over 6,000 people," from Wyoming Economic Development and Stabilization Board Community Business/Industrial Index, Powell, Wyoming, June 1986.

e = City engineer estimated 1987 Powell population at 6,000 (Myrick, 1987); no official estimates since 1980 Census (Lutterman, 1988).

Table 3-5. Recent Population Trends, Fremont County and City of Riverton, Wyoming.

	1980 (a)	1981	1982	1983 (b)	1984 (c)	1985 (b)	1986 (b)	1987 (b)	1988
Fremont County (d)	38,992	38,907	39,636	40,359	39,900	37,512	36,026	35,887	36,300
Riverton	9,588	N/A	N/A	10,438	N/A	10,300	10,100	9,681	9,792

a = Source: 1980 U.S. Census data from Wyoming Census Retrieval and Information Service, Report #5, October 1981.

b = Source: 1983, 1985-1987 Riverton estimates by Fremont County planner (Price, 1987).

c = Note: 1984 Bureau of the Census estimate for Fremont County was 37,335; 1984 City of Riverton population estimate was 9,946 (Wyoming Economic Development and Stabilization Board, Community Business/Industry Index, Riverton, Wyoming, 1986).

d = Source: 1980-1998 county estimates and projections from Wyoming Department of Administration and Fiscal Control, Statistics Divsion, 1988.

tax) and 38 percent was derived from state sources (primarily the state foundation program). Park County School District #1 expenditures totaled $8,707,845 in FY 1986-87.

Jurisdictions Outside the Primary Area of Site Influence

- Big Horn County;
- Town of Frannie;
- Town of Deaver;
- Big Horn School District #1.

3.2.4 Beaver Creek Project

Jurisdictions Within the Primary Area of Site Influence

- Fremont County;
- City of Riverton;
- Fremont School District #25;
- Fremont School District #1.

The Fremont County community of Riverton would be the destination community for Amoco's proposed busing program. Other jurisdictions outside the primary area of site influence have not been identified for the Beaver Creek Project.

Local Economy. Table 3-1 displays recent Fremont County employment and earnings trends. The Fremont County economy is based on tourism, government employment, the oil industry and agriculture. Until recently, the mining industry was the mainstay of the local economy. However, since 1980, mining sector employment fell 81 percent, from 3,950 in 1980 to 743 in 1988. Construction sector employment also dropped significantly, from 1,420 in 1980 to 984 in 1988, a 31 percent drop over the eight-year period.

As a result of the declines in these two industries, total Fremont County employment fell 19 percent during this period, from 19,845 in 1980 to 16,051 in 1988. Retail trade declined only 11 percent and the service sector remained relatively constant, reflecting the influence of tourism on those sectors. Government employment increased 12 percent during the eight-year period.

Correspondingly, gross earnings (adjusted to constant 1986 dollars) fell from $396,306,000 in 1980 to $225,006,000 in 1988, a 43 percent decrease (DAFC, 1986; DAFC, 1988).

Population. Table 3-5 presents recent population trends for Fremont County. The decline in the mining and construction industries resulted in loss of population in Fremont County. Total county population decreased from 38,922 in 1980 to 36,300 in 1988, a loss of 7 percent. However, the county's 1988 population was 10 percent less than the 1983 peak. The City of Riverton gained population during this period, growing from 9,588 in 1980 to 9,792 in 1988, an increase of 2 percent. However, the 1988 Riverton population estimate is down 6 percent from the peak year of 1983.

Housing. The most recent housing inventory for the City of Riverton was the U.S. Census. At that time there were 3,427 year-round occupied units (Bureau of Census, 1982). In December 1987 there were approximately 350 housing units for sale in the Riverton area. A December 1987 housing availability survey identified 25 apartments, 20 houses and 30 mobile homes for rent (see Table 3-3), although it was generally agreed that many more potential rental units exist. The survey also identified 350 vacant mobile home pads.

Of the 496 hotel and motel rooms in the Riverton area, an average of 125 would be available in summer and 372 in winter. There are 68 recreational vehicle pads in the area but the parks are typically filled with tourists in summer and closed during the winter months.

Local Government Facilities and Services. In general, public facilities and services provided by Fremont

County and the City of Riverton are adequate in capacity and condition to serve current population levels with some room for additional growth. An exception is the county road and bridge shop in Riverton which is currently inadequate in size (Lawrence, 1988).

Fremont County has been operating at reduced staff levels because of recent budget constraints and population loss. Significant population growth would cause demand for additional staff (Nicol, 1988).

Fremont County School District #25 serves the City of Riverton and surrounding area. The district operates four elementary schools, a middle school, a high school, a career center and an alternative school, all located in Riverton. One elementary school is currently unused. District #25 fall 1987 enrollment was 3,083, an increase of 2 percent from the previous year, but a decrease of 7 percent from the recent peak year (1980). It is estimated that the district could accommodate an additional 230 students (Baldwin, 1987).

Fremont County School District #1 serves Lander, Hudson and Atlantic City. The proposed Beaver Creek Recycle Plant would be constructed within the boundaries of District #1. The district operates five grade schools, one junior high school and one high school. District #1 fall 1987 enrollment was 2,062. The district has capacity in the existing schools for approximately 1,000 additional students (Coates, 1987).

Local Government Revenues and Expenditures. Fremont County revenues totaled $10,673,948 in FY 1986-87, a 19 percent decrease from the preceding year. Of this amount, 43 percent ($4,601,252) was obtained from property tax and 10 percent ($1,082,101) was derived from sales and use tax. Fremont County FY 1986-87 expenditures totaled $9,569,417.

City of Riverton revenues totaled $7,218,950 in FY 1986-87, a 15 percent decrease from the previous year. Of the total amount, 8 percent ($583,791) was obtained from sales and use tax and 18 percent ($1,298,609) was obtained from utility user fees. City of Riverton expenditures totaled $8,301,759 in FY 1986-87.

Fremont County School District #25 (Riverton) revenues totaled $13,588,752 in FY 1986-87, approximately the same as the previous year. Approximately 26 percent of the total was obtained from local and county sources (primarily property tax) and 74 percent was derived from state sources (primarily the state foundation program). District #25 expenditures totaled $13,136,398 in FY 1986-87.

Fremont County School District #1 (Lander) revenues totaled $9,780,213 in FY 1986-87, a 4 percent decrease over the previous year. Of the total, 33 percent was obtained from local and county sources and 66 percent was obtained from state sources. District #1 expenditures totaled $9,861,288 in FY 1986-87.

3.2.5 Little Buffalo Basin Project

Jurisdictions Within the Area of Site Influence

- Park County
- Washakie County;
- City of Worland;
- Town of Meeteetse;
- Park School District #16;
- Washakie School District #1.

The Washakie County community of Worland would be the destination community for Amoco's proposed busing program. A description of Park County economic, population and public facilities, services and fiscal conditions is provided in Section 3.2.3.

Local Economy. Table 3-1 presents recent Washakie County employment and earnings trends. The Washakie County economy is based primarily on agriculture, the oil industry and the manufacturing sector. Washakie County employment decreased from 5,206 in 1980 to 4,773 in 1988, or 8 percent over the eight-year period. Employment in the agriculture sector has remained relatively constant during this time, however, mining sector employment (primarily the oil industry) decreased dramatically from 381 in 1980 to 176 in 1988 or 53 percent. Manufacturing declined 12 percent during this period, from 518 in 1980 to 454 in 1988. The construction sector fell 18 percent, from 355 in 1980 to 292 in 1988. Gross earnings (adjusted to constant 1986 dollars) fell from $101,594,000 in 1980 to $80,595,000 in 1988 or 21 percent over the period (DAFC, 1986; DAFC, 1988).

Population. Table 3-6 presents recent population trends for Washakie County, the City of Worland and the Park County Town of Meeteetse. Washakie County population has increased 6 percent in the last eight years, from 9,496 in 1980 to 10,047 in 1988. The City of Worland's population increased 3 percent during the same period, from 6,391 in 1980 to 6,598 in 1988. The Town of Meeteetse population decreased from 512 to 479 people, a drop of 6 percent over the eight-year period.

Housing. The most recent housing inventory for the City of Worland was conducted during the 1980 Census. At that time, Worland had a total of 2,309 year-round occupied units (Bureau of Census, 1982).

A housing availability survey conducted in December 1987 identified approximately 100 single-family homes and 10 sited mobile homes for sale in Worland. At that time, approximately 35 single-family homes, 25 apartments and 12 mobile homes were for rent; 22 of Worland's 44 mobile home pads were vacant; and an average of 15 of Worland's 44 recreational vehicle sites are available during the summer months (Table 3-3). The survey also identified 9 motels with a total of 218 rooms. Of these, an average of 77 are typically available in the winter season. All rooms are typically filled during the summer months.

The Town of Meeteetse had an estimated 15 houses for rent in December 1987, according to the housing availability survey. Meeteetse has a total of 33 motel rooms and 14 RV pads. Vacancy of these units depends on seasonal work being performed at the Little Buffalo Basin Field.

Local Government Facilities and Services. In general, public facilities and services in Washakie County, the City of Worland and the Town of Meeteetse are adequate in condition and capacity to accommodate current population levels with some capacity for expansion. Both the City of Worland and the Town of Meeteetse may need additional staff to accommodate substantial population growth.

Park County School District #16 serves the Meeteetse area. The district operates one school that accommodates grades Kindergarten through 12. Fall 1987 enrollment was 221 students. The district has capacity in the existing schools for an additional nine students.

Washakie County School District #1 serves Worland and the western half of Washakie County. The district operates three elementary schools, a middle school and a high school. Fall 1987 enrollment totaled 1,843 students, a decrease of 6 percent from the previous year. The district has remaining capacity for 698 students; however, most of this capacity is in the middle and high schools. Two of the three grade schools have exceeded capacity and the third is near capacity.

Local Government Revenues and Expenditures. Washakie County revenues totaled $2,904,970 in FY 1986-87, a 38 percent decrease over the previous

Table 3-6. Recent Population Trends, Washakie County, City of Worland and Town of Meeteetse.

	1980 (a)	1981	1982	1983	1984	1985	1986	1987	1988
Meeteetse (b)	512	N/A	N/A	545	N/A	N/A	N/A	475	479
Washakie County (c)	9,496	9,663	9,798	10,070	10,300	10,442	10,226	9,999	10,047
Worland (d)	6,391	N/A	N/A	6,613	6,764	6,857	6,715	6,566	6,598

a - Source: 1980 U.S. Census data from Wyoming Census Retrieval and Information Service, Report #5, October 1981.

b - Source: 1987 estimate for Meeteetse by Town Clerk (Yetter, 1987).

c - Source: 1980-1995 county estimates and projections from Wyoming Department of Administration and Fiscal Control, Statistics Division, 1988.

d - Source: Wyoming Department of Administration and Fiscal Control, Statistics Division, 1988; Planning Information Corporation, 1988.

Table 3-7. Recent Population Trends, Natrona County and Selected Communities.

	1980 (a)	1981	1982	1983	1984	1985	1986	1987	1988
Natrona County (b)	71,856	75,992	75,552	75,096	75,024	72,449	67,156	65,005	65,581
Casper (c)	51,016	54,255	55,910	51,610	52,268	49,676	45,226	45,243	45,713
Edgerton (d,e)	510	N/A	N/A	503	N/A	N/A	512	485	489
Midwest (d,f)	638	N/A	N/A	630	N/A	N/A	N/A	632	638

a - Source: 1980 U.S. Census data from Wyoming Census Retrieval and Information Service, Report #5, October 1981.

b - Source: County 1980-87 estimates and 1988-98 projections from Wyoming Department of Administration and Fiscal Control, Statistics Division, 1988.

c - Source: 1981-86 estimates and 1987-2000 projections from City of Casper Planning Department (Payne, 1987).

d - Source: 1983 estimates for Edgerton and Midwest from Wyoming Department of Administration and Fiscal Control, Research and Statistics Division, 1983 Population Estimtes prepared for Wyoming Liquor Commission.

e - Source: 1986 and 1987 estimates for Edgerton by Town Clerk (McCoy, 1987).

f - Source: 1987 estimate for Midwest by Mayor (Chaffin, 1987).

year. However, FY 1985-86 revenues included a $1,302,070 state grant. Of the total FY 1986-87 revenues, 7 percent ($209,057) was obtained from sales and use tax and 42 percent ($1,229,437) was derived from property taxes. Washakie County expenditures totaled $2,430,701 in FY 1986-87.

City of Worland revenues totaled $3,129,357 in FY 1986-87, a 19 percent decrease from the preceding year. Of that total, 16 percent ($495,233) was derived from sales and use taxes and 34 percent was obtained from utility user fees. City of Worland expenditures totaled $3,499,127 in FY 1986-87.

Town of Meeteetse revenues totaled $241,159 in FY 1986-87, a 17 percent decrease from the previous year. Of the total amount, 21 percent ($51,663) was obtained from state sales and use tax and 26 percent ($62,650) was obtained from utility user fees. Town of Meeteetse expenditures totaled $295,126 in FY 1986-87.

Park County School District #16 revenues totaled $3,459,502 in FY 1986-87, a 2 percent increase over the previous year. Of the total amount, 97 percent ($3,361,534) was obtained from local and county sources (property tax). School District #16 does not receive funds from the state foundation program. School District #16 expenditures totaled $4,376,932 in FY 1986-87. Of that amount, 32 percent ($1,396,949) went to the state recapture program.

Washakie County School District #1 revenues totaled $8,707,449 in FY 1986-87, approximately the same as the previous year. Of the total amount, 29 percent was derived from local and county revenues (property tax) and 71 percent was derived from state funds (primarily the state foundation program). District #1 expenditures totaled $8,429,279 in FY 1986-87.

3.2.6 Salt Creek Project

Jurisdictions Within the Primary Area of Site Influence

- Natrona County;
- City of Casper;
- Natrona School District #1;
- Town of Midwest;
- Town of Edgerton.

The City of Casper would be the destination community for Amoco's proposed busing program.

Local Economy. Table 3-1 presents recent employment and earnings trends for Natrona County. The economy of Natrona County is based primarily on the oil and gas industry and on Casper's position as a regional trade center. The recent decline in oil prices generated a corresponding decline in employment and population in Natrona County. Total Natrona County employment fell from a peak of 49,350 in 1981 to 35,648 in 1988, a 28 percent decline. Mining sector employment (which includes the oil and gas industry) fell from a 1981 peak of 9,589 to an estimated 3,254 in 1988, a 66 percent decrease over the seven-year period. Employment in linked sectors, such as construction and manufacturing, showed declines (42 percent for construction and 31 percent for manufacturing) during the same period. Gross earnings (adjusted to 1986 dollars) displayed a corresponding decline, from $1,144,361,000 in 1981 to $635,452,000 in 1988, a 44 percent decrease (DAFC, 1986; DAFC, 1988).

Population. Table 3-7 lists recent population trends for Natrona County, the City of Casper, the Town of Edgerton and the Town of Midwest. Natrona County population fell from the 1981 peak of 75,992 to 65,581 in 1988, a decrease of 14 percent. Approximately 98 percent of this population loss occurred in the City of Casper. Casper population fell from a peak of 55,910 in 1982 to 45,713 in 1988, a decrease of 18

percent. Edgerton population fell slightly, from 510 in 1980 to 489 in 1988; Midwest population remained the same at 638 in both years.

Housing. The 1980 census identified 18,874 year-round occupied housing units in Natrona County. In December 1987, there were approximately 1,000 single-family homes for sale and 1,730 apartments for rent in the Casper area (Dennis, 1988). Of the 1,961 motel rooms in the city, an average of 980 are available in both winter and summer seasons (Table 3-3).

A December 1987 housing availability survey identified approximately 5 houses for rent and 10 house for sale in the Town of Midwest and 16 housing units for rent in Edgerton. There were 6 vacant mobile home pads in Midwest at this time and 44 in Edgerton. Neither town has vacant hotel or motel rooms during summer months.

Local Government Facilities and Services. Public facilities provided by Natrona County, the City of Casper and the Towns of Midwest and Edgerton are adequate in condition and capacity to serve existing population levels with some capacity for additional growth, with the following exceptions: 1) the Natrona County Sheriff's Department has adequate office space, but no surplus capacity; 2) the Natrona County Jail has ample space, but does not house juveniles in a separate building (Benton, 1987); 3) the Casper fire station is not large enough for existing equipment (Sullivan, 1987); 4) the county-owned hospital is about to undertake a $33 million renovation to improve mechanical-electrical capabilities and to solve other problems (Hall, 1988); and 5) water supply from wells is not adequate in quantity to serve the Town of Edgerton. The town hopes to secure treated water from Casper, which would require installation of a new pipeline (Patterson, 1987a). Both Natrona County and Casper are able to accommodate substantial growth considering population loss in recent years.

Natrona County School District #1 serves Casper, Midwest and Edgerton. The district operates 30 grade schools, 5 middle schools and 3 high schools, as well as 2 special schools and 2 alternative schools. Fall 1987 enrollment was 12,670, a decrease of 12 percent over the peak enrollment of 14,392 which occurred in 1982. School district #1 has capacity in existing schools for about 2,500 additional students. Midwest Elementary, Junior High and High School serve the towns of Midwest and Edgerton, with capacity for 402 students and a fall 1987 enrollment of 245 students.

Local Government Finance. Natrona County revenues totaled $13,933,101 in FY 1986-87, a 20 percent decrease from the previous year. Most of this decrease resulted from decreases in federal funds, revenues from other local governments and sales and use tax revenues. Of the total FY 1986-87 revenues, 40 percent ($5,486,431) were from property tax, and 20 percent was derived from state and local option sales tax. FY 1986-87 expenditures for Natrona County totaled $15,886,155.

City of Casper revenue totaled $30,910,059 in FY 1986-87, a 25 percent decrease from the preceding year. This decrease was due primarily to declines in sales and use tax revenues, other state-shared revenues and federal funds. Casper received 31 percent of its FY 1986-87 revenues from sales and use tax and 24 percent from utility user fees and trash collection revenues. City of Casper expenditures totaled $27,919,627 in FY 1986-87.

Town of Midwest revenues totaled $419,690 in FY 1986-87, a 20 percent decrease from the previous year. Of the total amount, 29 percent ($121,753) was derived from sales and use tax and 16 percent ($65,864) was derived from utility user fees. Total Town of Midwest expenditures were $472,353 in FY 1986-87.

Town of Edgerton revenues totaled $288,823 in FY 1986-87, a 16 percent decrease from the previous year. Of that total, 34 percent ($97,130) was derived from state and local option sales and use tax and 17 percent ($47,952) was derived from utility user fees and trash collection revenues. Total expenditures for the Town of Edgerton were $200,534.

Natrona County School District #1 revenues totaled $55,622,174 in FY 1986-87, approximately the same as the previous year. Of that total, 31 percent ($17,045,514) was obtained from local and county sources and 69 percent ($38,576,660) was obtained from the state sources. Total FY 1986-87 expenditures for Natrona County School District #1 were $52,030,010.

3.2.7 Beaver Creek Alternative

Socioeconomic baseline conditions for this alternative are the same as those described for the Beaver Creek Project in Section 3.2.4.

3.2.8 Frontier/Casper Alternative

Socioeconomic baseline conditions for this alternative are the same as those described in Section 3.2.2 for the Fontenelle Project and Section 3.2.6 for the Salt Creek Project. Pipeline construction crews associated with this alternative would reside in Green River and Casper.

3.2.9 Exxon Alternative CO_2 Supply

Jurisdictions within the primary area of site influence for Phase II of Exxon's LaBarge Project include a large portion of southwestern Wyoming. Jurisdictions evaluated in the Phase II Wyoming Industrial Siting Application (Exxon, 1985) include the following:

- Counties
  - Sweetwater
  - Lincoln
  - Sublette
- Municipalities
  - Rock Springs
  - Green River
  - Granger
  - Kemmerer
  - Diamondville
  - Opal
  - LaBarge
  - Big Piney
  - Marbleton
  - Pinedale
- School Districts
  - Lincoln School District #1
  - Sweetwater School District #1
  - Sweetwater School District #2
  - Sublette School District #1
  - Sublette School District #9

Baseline conditions for each of these jurisdictions is described in detail in the Exxon Industrial Siting Application. For a complete discussion of present and projected baseline conditions, the reader is referred to Exxon's application.

3.2.10 No Action Alternative

The baseline socioeconomic conditions for the No Action Alternative are the same as those previously described for Amoco's Proposed Actions in Section 3.2.2 through 3.2.6.

3.3 SOILS AND VEGETATION

3.3.1 Introduction

General Soils

The distribution of general soils types in the vicinity of the proposed projects and alternatives is indicated on Figure 3-1. More detailed, Order 3 survey data are available for most of the area and are mapped for the five fields and for one mile on either side of all spur and trunk pipelines

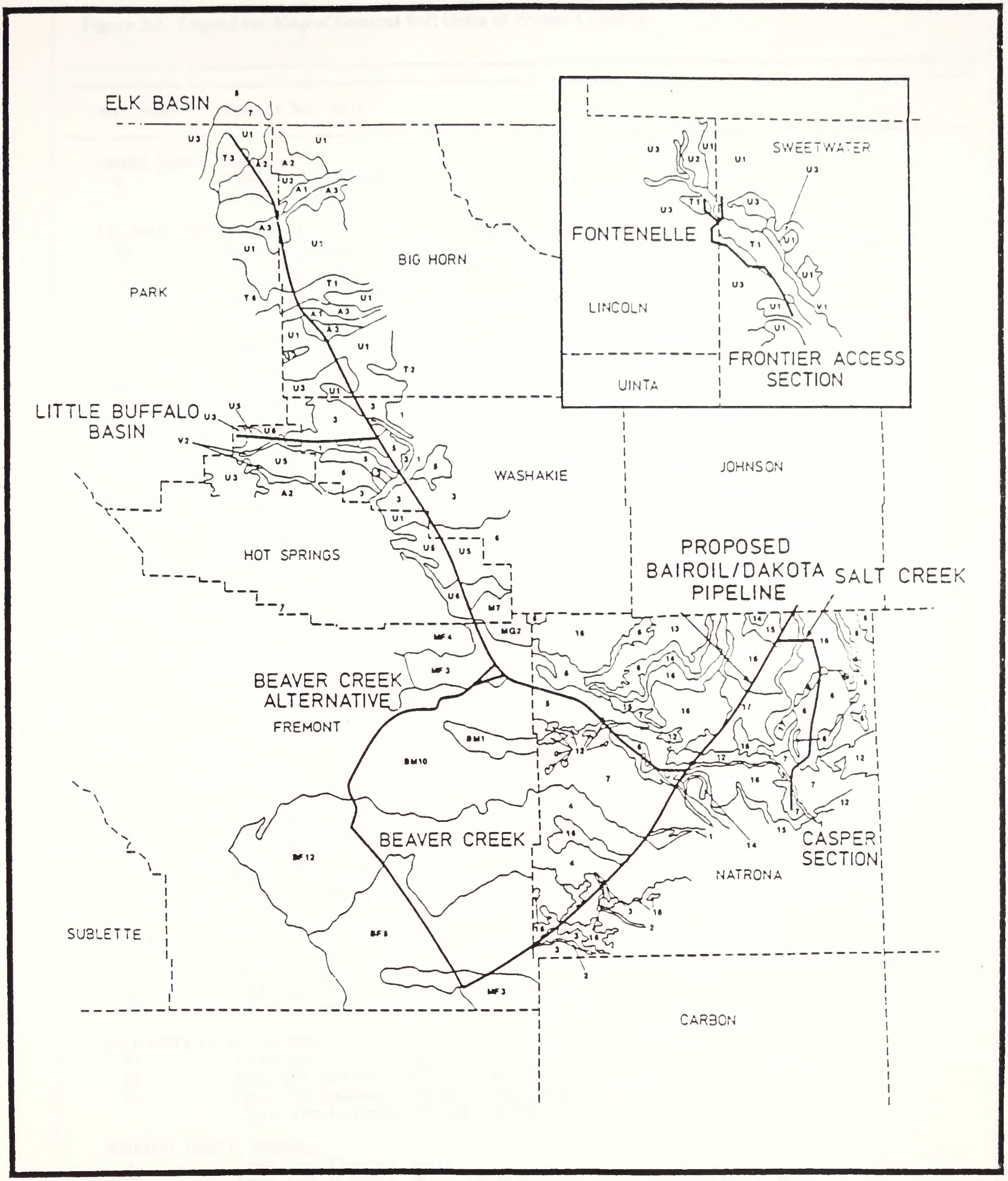


Figure 3—1. Distribution of General Soil Units of Project Counties.

Figure 3-1. Legend for Map of General Soil Units of Project Counties.

Map Symbol	General Soil Unit
CARBON COUNTY, MONTANA:	
5	Midway - Travessila
7	Harvey - Stormitt
BIG HORN COUNTY, WYOMING:	
A1	Typic Fluvaquents, mesic - Typic Torriorthents, mesic - Typic Torrifluvents, mesic
A3	Typic Torrifluvents, mesic - Typic Natrargids, mesic
T1	Typic Haplargids, mesic
U1	Typic Torriorthents, mesic - Rock outcrop
FREMONT COUNTY, WYOMING:	
BF8	Torriorthents - Haplargids - Rock outcrop
BF12	Haplargid - Torriorthents
MF3	Haploborolls - Argiborolls - Rock outcrop
MF4	Haploborolls, shallow
BM10	Haplargids - Torriorthents
HOT SPRINGS COUNTY, WYOMING:	
F1	Ustic Torriorthents, frigid - Rock outcrop
M7	Rock outcrop - Argic Cryoborolls - Lithic Cryoborolls
U1	Typic Torriorthents, mesic shallow - Rock outcrop - Typic Torrifluvents, mesic
U3	Borollic Haplargids - Rock outcrop - Ustic Torriorthents, frigid
U6	Ustic Torriorthents, mesic - Rock outcrop
V2	Ustic Torriorthents, frigid, mesic
LINCOLN COUNTY, WYOMING:	
T1	Typic Calciorthids, frigid - Typic Torriorthents, frigid - Typic Torrifluvents, frigid - Rock outcrop
U1	Typic Torriorthents, frigid - Typic Torrifluvents, frigid - Typic Calciorthids, frigid - Rock outcrop
U3	Typic Torriorthents, frigid - Typic Calciorthids, frigid - Typic Torripsamments, frigid - Rock outcrop
V1	Ustic Torrifluvents, frigid - Fluvaquentic Halaquepts, frigid - Typic Cryaquolls, frigid - Typic Cryaquents, frigid - Riverwash
NATRONA COUNTY, WYOMING:	
1	Ustic Torrifluvents, mesic-Ustollic Natrargids, mesic
6	Ustic Torriorthents, mesic - Borollic Lithic, mixed - Rock outcrop
7	Ustollic Haplargids, mesic - Ustollic Natrargids, mesic-Ustic Torriorthents, mesic
8	Ustollic Haplargids, mesic - Ustic Torriorthents, mesic
9	Typic Haplargid, mesic - Typic Haplargids, mesic - Typic Torriorthents, mesic
12	Ustic Torripsamments, mesic - Ustollic Haplargids, mesic - Ustollic Haplargids, mesic
16	Typic Torriorthents, mesic - Ustollic Camborthids, mesic - Ustollic Natrargid, mesic
17	Ustollic Camborthids, mesic - Haplustollic Natrargid, mesic
PARK COUNTY, WYOMING:	
T3	Ustollic Haplargids - Ustic Torriorthents, mesic, shallow
T5	Typic Haplargids, mesic
U1	Typic Torriorthents, mesic - Rock outcrop
U2	Typic Torriorthents, mesic - Rock outcrop
SWEETWATER COUNTY, WYOMING:	
T1	Typic Calciorthids, frigid
U1	Typic Calciorthids, frigid - Typic Torriorthents, shallow
U3	Typic Torripsamments, frigid - Typic Natrargids, frigid - Typic Torriorthents, frigid, shallow
WASHAKIE COUNTY, WYOMING:	
1	Typic Torrifluvents, mesic
3	Typic Torriorthents, mesic - Rock outcrop - typic Torrifluvents, mesic
5	Typic Haplargids, mesic - Typic Natrargids, mesic
6	Ustic Torriorthents, mesic - Ustollic Haplargids, mesic

(considered the "study area" in this section) in the Soils, Vegetation and Agriculture Technical Report and its accompanying soil maps.

Soils that are particularly susceptible to impacts and that may be disturbed during construction of one or more projects or alternatives are considered "fragile" soils. Delineation of fragile soils was based on the following Bureau of Land Management (1985a) criteria:

- o Shallow over bedrock (less than 20 inches);
- o Underlain by hard bedrock;
- o Sand, loamy sand and clay-textured surface and subsoil layers;
- o Containing more than 35 percent coarse fragments by volume;
- o *Permeability* less than 0.6 inches per hour;
- o Water table less than 72 inches;
- o Soil reaction with *pH* greater than 8.5, salinity more than 16 millimhos in the upper 40 inches;
- o Occupying slopes steeper than 15 percent.

While the potential for having a slope limitation is indicated by the soil unit, actual steep slope locations were also identified (from 1:24,000 topographic maps) by milepost locations along each spur and trunk pipeline route. Only significant areas of steep slopes (i.e., areas at least 0.1 mile long) were identified.

General Vegetation Types

Vegetation varies in the study area with soils, climate, elevation and land management practices. *Vegetation types* were described and mapped using aerial photography (LANDSAT imagery and color video tape), Soil Conservation Service vegetation descriptions and range site delineations, and BLM file and published maps. Nine vegetation or land cover types were mapped in the project areas: sagebrush/grassland, desert shrub, grassland, mixed shrub, coniferous woodland, riparian, cropland, barren/badlands and disturbed areas. These vegetation types are described below:

Sagebrush/Grassland. Sagebrush/grassland vegetation can be found on a variety of soil types, topography and elevation but most commonly occupies gently rolling hills. Within the community, composition varies with shrubs (constituting from 40 to 70 percent), grasses (30 to 60 percent) and forbs (a trace to about 10 percent). Soil Conservation Service designations of potential vegetation composition frequently indicate less shrub cover (Soil Conservation Service, 1986). A high percentage of shrub cover is indicative of range deterioration in many cases (BLM, 1988).
Wyoming big sagebrush usually dominates the vegetation type but basin big sagebrush and black sagebrush subtypes are also present. Wyoming big sagebrush is the most widely distributed in the study areas and is the most *xeric* member of the big sagebrush group. Black sagebrush dominated areas are usually at higher elevations, often in the transition zone to mountain brush communities and seem to have an affinity for calcareous soils with a lot of surface rock or pavement (Winward, 1980). Basin big sage is frequently found in more *mesic* valley bottom communities and may, therefore, also be mapped as a riparian vegetation type. Many basin big sage communities throughout the West have been converted to cropland (Winward and Tisdale, 1969).

Common grasses of the sagebrush/grassland type are western wheatgrass, thickspike wheatgrass, Indian ricegrass, needle and thread, green needlegrass, bluebunch wheatgrass, sandberg bluegrass, Idaho fescue and threadleaf sedge (BLM, 1978; BLM, 1982c; BLM, 1986b; BLM, 1988).

Desert Shrub. The desert shrub type is a low stature, low density shrub-dominated type characteristic of the

more alkaline soils of the area. Total plant cover may average as little as 10 percent. Gardner saltbush is the most common dominant, although Nuttall saltbush, birdsfoot sage, shadscale or fourwing saltbush may be co-dominants or may dominate sub-types depending on soils, management and other factors (BLM, 1978; Affinis, 1986; BLM, 1982c; BLM, 1986b; BLM, 1988). Shrubs may constitute as much as 90 percent of total cover (BLM, 1982a), although the potential composition of desert shrub communities (e.g., saline upland, impervious clay or shale range sites) is about 40 to 50 percent grasses, 10 percent forbs and 40 to 50 percent shrubs (Soil Conservation Service, 1986).

Other common shrubs of the desert shrub vegetation type are spiny hopsage, spineless horsebrush, bud sagebrush, winterfat and greasewood. Understory species include bottlebrush squirreltail, Indian ricegrass, thickspike wheatgrass, needlegrass and western wheatgrass.

Grassland. This primarily herbaceous type occurs on level to rolling topography. The dominant grass species include bluebunch wheatgrass, western wheatgrass, Indian ricegrass, blue grama, buffalo grass, sideoat grama, needlegrass, sandberg bluegrass, June grass and Idaho fescue. Common forb species include yarrow, phlox, buckwheat, golden aster, blazing star, prickly pear cactus, locoweed and goldenrod (BLM, 1986b; BLM, 1985a; Kaul, 1986). Overgrazed grasslands often deteriorate to shrub-dominated communities or form a mosaic with the sagebrush/grassland types (BLM, 1988). Therefore, areas classified as grassland may include areas dominated by sagebrush.

Mixed Shrub. The mixed shrub type includes a variety of shrub-dominated communities which are either so heterogeneous that they cannot be categorized within the other types or are composed of an intricate mosaic of other types. Many of the shrubs of this type also occur as dominants or co-dominants of other types, including big sagebrush, shadscale and Gardner saltbush, rubber rabbitbrush, greasewood, horsebrush and spiny hopsage. Shrubs of this type which are not common constituents of other types are skunkbrush sumac and fringed sage.

The mixed shrub type is used primarily to delineate sparsely vegetated shrublands of moderate to steep slopes. Soils are generally thin and/or rocky. This type has not been used to denote dense, mixed shrub bottomlands. The latter have been classified as riparian or sagebrush-/grassland, as appropriate.

Coniferous Woodland. Tree density within a coniferous woodland may vary from a few scattered trees on rocky outcrops to true dominance by the species in large forests. Within the study areas, coniferous woodlands are limited to scattered trees on moderate to steep slopes with shallow and rocky soils. The study area does not include any stands of harvestable timber. Overstory species include both Utah and Rocky Mountain Juniper and limber pine. Common understory species are big sagebrush, rabbitbrush, western wheatgrass, bottlebrush squirreltail, Indian ricegrass, bluebunch wheatgrass, prairie junegrass and needle-and-thread grass (BLM, 1985a; BLM, 1988).

Riparian. The riparian type is one of the most limited in extent, yet the most diverse within the study areas. In general terms, riparian areas are "the green zones along the banks of rivers and streams and around springs, bogs, wet meadows, lakes and ponds" (BLM, 1987a). The riparian type is not intended to correspond to the more limited regulatory definition of "wetland" employed by the U.S. Army Corps of Engineers.

The riparian type occupies flat to gently sloping bottomlands and terraces in a variety of soil types. Whether the adjacent water body is perennial, intermittent or ephemeral, riparian vegetation is influenced by

the water body during at least part of the growing season. The influence may be direct, e.g., by periodic flooding, or indirect, e.g., from a high water table such as in sub-irrigated meadows or many greasewood communities. Despite their relatively homogeneous topography, riparian communities are characterized by both temporal and spatial variation in vegetation in response to changes in amount and quality of water.

Riparian areas are frequently characterized by bands or zones of different vegetation. Changes in available water which create much of this zonation may be influenced by slight changes in elevation, distance from the water body or the influence of soil texture (porosity) on available water. The riparian type includes tree, shrub and herb dominated communities. Common tree dominants are cottonwood, hawthorn, Russian olive, water birch or peachleaf willow. Shrub-dominated communities usually include a variety of genera and species including willows, tamarisk, dogwood, chokecherry, gooseberry, big sagebrush, rubber rabbitbrush or greasewood. Graminoids may include many upland species from adjacent communities plus more water and/or salt tolerant species such as inland saltgrass, alkali cordgrass, tufted hairgrass, alkali sacaton, basin wildrye, baltic rush and Nebraska, inland and golden sedge. Forbs may be common but are not usually dominant (BLM, 1985b; BLM, 1986b; Windell et al., 1986).

Cropland. Cropland includes both irrigated and non-irrigated row and *forage* crops including managed pastures. Common crops of the study area include sugar beets, alfalfa, corn, wheat and native grass pasture. The distinction between the riparian type and cropland is not always clear, particularly in bottomlands along the streams. For example, sub-irrigated native grass meadowland (a herbaceous riparian type) is typically cut for hay or used to pasture livestock. While the types may be interchangeable in small areas, bottomland fields cut for hay are generally designated as cropland and grazed meadows and fields interspersed with willows or cottonwoods are generally mapped as riparian.

Barren/Badlands. The barren/badlands designation is more properly a "landform" or "cover" type rather than a "vegetation" type, but it has traditionally been used to designate areas of extremely sparse vegetation and/or steep, highly erodible terrain. This designation includes Soil Conservation Service soils delineated as "Badlands" or "Rock outcrop" unless another vegetation type, typically coniferous woodland or desert shrub, could reasonably be assigned to the area. Many badlands areas support a very sparse saltbush community, but retention of the barren/badlands type serves to distinguish between productive Gardner saltbush (desert shrub) communities on gentle to moderately sloping topography and the sparse, relatively unproductive communities of steep, erodible slopes.

Disturbed. Small areas of disturbance, e.g., roads, houses, corrals, utility lines, existing pipelines, etc., are included in all of the other designated vegetation types. Significant areas of manmade disturbance, e.g., industrial facilities and cities, are specifically delineated as disturbed.

Ranges in potential production estimated by the Soil Conservation Service for project area range sites are summarized in Table 3-8.

Plants of Special Interest. Although no federally listed or proposed threatened or endangered plants occur in the vicinity of Proposed Action project components, several taxa of special interest have been identified as occurring or potentially occurring in the vicinity of several projects. Taxa were identified either by the proximity of known occurrences of populations to the project area or by existence of suitable *habitat* in the

Table 3-8. Potential Vegetation Production for Project Vegetation Types. (a)

		Range of Potential Production (pounds per acre)		
Symbol	Vegetation Type (b,c)	Unfavorable Years	Favorable Years	Normals
Fontenelle Project				
S/G	Sagebrush/Grassland	200-350	450-700	350-500
DS	Desert Shrub	150-300	300-700	200-500
G	Grassland	200	450	350
R	Riparian	800	2000	1200
Elk Basin Project				
S/G	Sagebrush/Grassland	100-600	300-1400	200-1100
DS	Desert Shrub	85-350	250-700	150-500
G	Grassland	100-850	300-2000	200-1500
MX	Mixed Shrub	160-700	400-1200	300-900
CW	Coniferous Woodland	160-500	400-1100	300-700
R	Riparian	350-3000	800-6000	525-4500
C	Cropland (d)	85-1400	250-2600	150-2400
Beaver Creek Project				
S/G	Sagebrush/Grassland	350-1200	700-2200	500-1800
DS	Desert Shrub	275	650	400
G	Grassland	300-1200	650-2400	450-1800
MX	Mixed Shrub	500-700	1000-1500	800-1200
CW	Coniferous Woodland	400-700	900-1200	650-900
R	Riparian	1200-2500	2500-3400	1800-3000
C	Cropland	700	1200-1500	700-1200
Little Buffalo Basin Project				
S/G	Sagebrush/Grassland	100-500	300-1100	200-800
DS	Desert Shrub	85-500	250-1100	150-800
G	Grassland	100-500	450-1100	
CW	Coniferous Woodland	350	700	
R	Riparian	600-1800	1200-2600	1000-2400
C	Cropland	200-1800	550-2600	350-2400
Salt Creek Project				
S/G	Sagebrush/Grassland	400-750	900-1800	700-1300
DS	Desert Shrub	200-500	400-900	300-700
G	Grassland	700	1200-1500	900-1200
R	Riparian	700-1200	1600-2500	1700-1800

Table 3-8. **Continued.**

Symbol	Vegetation Type (b,c)	Range of Potential Production (pounds per acre) Unfavorable Years	Favorable Years	Normals
Beaver Creek Alternatives				
S/G	Sagebrush/Grassland	225-1200	600-2200	400-1800
MX	Mixed Shrub	500-700	1000-1500	800-1200
G	Grassland	100-700	300-1500	200-1200
R	Riparian	700	1600	1200
Frontier/Casper Alternative				
Frontier Section				
S/G	Sagebrush/Grassland	200-350	450-700	350-500
DS	Desert Shrub	150-300	300-700	200-500
R	Riparian	800	2000	1200
Casper Section				
S/G	Sagebrush/Grassland	400-700	900-1500	700-1200
DS	Desert Shrub	200-500	400-900	300-700
G	Grassland	600-2500	1200-3500	900-3000
R	Riparian	1200-2500	2500-3500	1800-3000

a = Source: Compiled from Soil Conservation Service range site descriptions (Soil Conservation Service, 1986).
b = Barren/Badlands are not included because the Soil Conservation Service does not generally rate them for production.
c = Disturbed areas are not included because their potential productivity may have been severely modified.
d = Potential production for cropland is the potential production for native vegetation without irrigation. Very low production usually indicates that a desert shrub community has been converted to irrigated cropland.

project area. The Wyoming Department of Environmental Quality--Land Quality Division, the Wyoming office of the Rocky Mountain Heritage Task Force and the U.S. Fish and Wildlife Service (see Appendix 2) identified and provided location and habitat information on the plants of special interest.

Poisonous Plants and Noxious Weeds. Many poisonous plants are a natural constituent of the ecosystem and must be eaten in large quantities to be deadly. Several factors influence the degree of hazard posed by poisonous plants. These include seasonal susceptibility to the plant or portions of it, mineral deficiencies in the livestock's diet and large concentrations of poisonous plants in areas of limited forage availability (BLM, 1986a). Noxious weeds are opportunistic, introduced species and can become particular problems when the native community is disturbed. Halogeton is an example of a noxious and poisonous weed which invades disturbed areas (BLM, 1984a; BLM, 1985b; BLM, 1986a). It can be both dangerous to livestock and can inhibit successful revegetation. Table 3-9 lists the common poisonous plants and noxious weeds of the project areas.

3.3.2 Fontenelle Project

Soils. The Fontenelle Gas Gathering System, plant and wellfield-related activities and facilities would affect a variety of soils. These soils are formed in alluvium, aeolian sand deposits and residuum. Bedrock is shale and sandstone. Soils range in texture from clayey to sandy skeletal with most being well drained to excessively drained. The latter include very deep soils in sand hills.

Topography traversed by the gas gathering system ranges from nearly level flood plains and bottomlands of the Green River to gently sloping stream terraces and alluvial fans to moderately steep soils on upland plains. Slopes traversed by the gas gathering system would be generally less than 15 percent except in the vicinity of Slate Creek (see Table 3-10). Preliminary Order 3 survey data are available for about 15 miles of the 26-mile gas gathering system in Lincoln County. Sweetwater County soil data are from a more general survey (BLM, 1978). Of the 15 miles of surveyed route, less than 1 mile has only shallow soil limitations and 3.2 miles have shallow soils with low permeability.

Virtually all of the plant site and its access road have fine-textured soils with permeability and salinity problems. Soils of the plant site are extrapolated from adjacent surveyed soils and aerial photographs.

The majority of the wellfield has shallow to moderately deep, well drained soils of upland plains above the Green River and Fontenelle Reservoir. An Order 3 survey is not available for the wellfield but a general soil map (BLM, 1978) indicates that the principal limiting feature in the wellfield would be shallow soils with low permeability. Over half of the Raptor Field is covered by waters of Fontenelle Reservoir or has slopes greater than 15 percent.

Vegetation. Vegetation is fairly uniform within the project area but varies with soils and topography. The project area lies within the Green River and Great Divide Basin 7-to 9-inch precipitation zone (Soil Conservation Service, 1970). The gas gathering system will affect three vegetation types: sagebrush/grassland, desert shrub and riparian. Sagebrush/grassland is the dominant type in the area. The plant site is a mosaic of grassland and the greasewood sub-type of the riparian vegetation type. The wellfield is primarily sagebrush/grassland.

One plant of special interest, the starvling milkvetch (*Astragalus jejunus ssp. nov.*), a Category 2 plant thought to be a new subspecies, is known from the general vicinity of the Fontenelle

Table 3-9. Common Polsonous Plants and Noxious Weeds of the Project Areas. (a)

Poisonous Plants	Habitat	Dangerous Season	Livestock at Risk
Arrowgrass	Wet and alkaline bottomlands	All	All, including horses
Chokecherry	Moist deep soils mostly in foothills	All	All, especially sheep
Cocklebur	Irrigated fields and wet places	Spring	All, especially cattle and pigs
Deathcamus	Foothills	Early spring	All, especially sheep
Greasewood	Alkaline bottomlands and washes	Spring	All, but mostly sheep
Halogeton	Disturbed sites, roads	Fall, Winter	All, but mostly sheep
Horsebrush	Mostly dry, semi-deserts	Spring	All, but mostly sheep
Horsetail	Irrigated fields and wet places	Haying season	All, especially cattle and horses
Larkspur	Foothills, deserts	Early spring	Cattle
Locoweed	Desert to mountains	All, especially spring	All
Lupine	Mountain foothills areas of deep soils	Most when in fruit	Sheep
Milkvetch	Desert to mountains	All, especially spring	All
Senecio	Desert to mountains	Spring and summer	All
Tansy mustard	Sandy alkaline soils	Summer	Cattle

Noxious Weeds	Habitat	Flowering Season	Problem
Canada thistle	Valleys to mid-montane; wet to mesic sites	Flowers July - Aug.	Can spread asexually
Henbane	Pastures, fencerows, roadsides and waste areas	Flowers July - Aug.	Occasional livestock poisoning although not usually grazed
Halogeton	Overgrazed fields, roadsides and waste places	Flowers in fall	Adapted to alkaline soils and semi-arid environment; readily invades disturbances
Musk thistle	Cropland, pasture, range, forest, roadsides and stream banks	Flowers June - Aug.	Spreads rapidly forming dense stands
Russian knapweed	Cultivated fields, pastures, orchards and roadsides	Flowers June - Sept.	Roots to 8 feet
Whitetop	Alkaline disturbed soils	Flowers early summer	Highly competitive

a - Source: BLM, 1986b; BLM, 1985b; Stoddard et al., 1975; James and Kaller, 1980; Whitson, 1987.

Table 3-10. Steep Slope Areas Identified for Proposed and Alternative Projects.

Project	Milepost	Description
Fontenelle Project		
	7.2w	Slate Creek
Elk Basin Project		
	8.9 - 9.6	Approach to Polecat Bench
	13.8 - 14.0	Miscellaneous
	14.3 - 14.4	
	20.1 - 20.2	
	29.5 - 29.6	
	33.3 - 33.4	
	35.8 - 35.9	
	36.5 - 36.7	
	44.3 - 44.4	
	49.2 - 49.3	
	51.2 - 51.3	
	53.8 - 54.0	Sheep Mountain/Red Butte area
	54.1 - 54.6	
	55.0 - 55.1	
	56.0 - 56.6	
	57.1 - 57.3	
	57.4 - 57.5	
	57.8 - 59.0	
	73.1 - 73.2	Miscellaneous
	75.0 - 75.1	
	75.4 - 75.5	
	88.0 - 88.3	Cedar Mountain area
	92.2 - 92.4	
	92.8 - 92.9	Drainages in Zimmerman Butte area
	93.4 - 93.5	
	93.9 - 94.0	
	95.3 - 95.5	
	96.1 - 96.2	
	96.5 - 96.6	
	97.0 - 97.3	
	97.5 - 97.6	
	98.6 - 98.7	
	99.3 - 99.4	
	102.6 - 102.7	Kirby Creek area
	103.2 - 103.4	
	110.0 - 110.1	
	111.2 - 111.7	
	112.5 - 113.1	
	113.6 - 113.7	
	114.0 - 114.2	
	114.3 - 114.7	
	115.2 - 115.4	
	115.7 - 115.8	

Table 3-10. Continued.

Project	Milepost	Description
	116.0 - 116.5 116.8 - 117.0 117.3 - 117.8 118.1 - 118.2 118.5 - 118.7	Kirby Creek and Lysite Mountain area
	119.2 - 119.6 120.1 - 120.9 121.2 - 121.3 123.1 - 123.2	Bridger Creek Vicinity and Lysite Mountain area
	128.9 - 129.2 132.9 - 133.2	Miscellaneous
	168.6 - 168.7 169.4 - 169.5	Hells Half Acre
Beaver Creek Project		
	11.8 - 13.3	Beaver Divide
	13.8 - 13.9 14.3 - 14.5 15.8 - 15.9 22.1 - 22.3 26.8 - 26.9 34.7 - 34.8 36.9 - 37.0 42.8 - 43.2	Miscellaneous
Little Buffalo Basin Project		
	2.9 - 3.0	Miscellaneous
	3.5 - 3.7 4.1 - 4.3 4.6 - 4.7	East rim of Little Buffalo Basin
	5.0 - 5.1 6.3 - 6.4 7.7 - 7.8 8.1 - 8.3	Miscellaneous
	8.7 - 8.9	Bluff above Buffalo Creek
	9.5 - 9.6 9.8 - 10.1 11.9 - 12.0 12.2 - 12.3 27.7 - 28.3 34.3 - 34.4	Miscellaneous

Table 3-10. Continued.

Project	Milepost	Description
Salt Creek Project		
	0.5 - 1.2	Miscellaneous
	3.3 - 3.4	
Beaver Creek Alternative		
	0.7 - 0.8	Miscellaneous
	7.0 - 7.4	
	33.4 - 33.6	Bluff above Highway 20-26
	41.0 - 42.0	Bluff above Badwater Creek
	53.4a - 53.6a	Bluff above Bridger and Cottonwood Creek
	54.5a - 55.0a	
Frontier/Casper Alternative Frontier Section		
	5.3 - 5.7	Ridge above South Fork Creek
	6.3 - 6.4	Ephemeral drainage
	8.8 - 8.9	Ephemeral drainage
	9.3 9.8	Dissected bench
	10.0 - 10.8	Descending from bluff; already a pipeline; narrow
	12.9 - 13.1	Gravel pit
	13.8 - 14.0	Close to steep slope; pipeline may cut slope
	14.1 - 14.2	Ephemeral drainage to Green River
	14.8 - 14.9	West Otterson Wash
Casper Section		
	3.7 - 3.8	Ephemeral drainages
	5.6 - 5.9	
	6.5 - 6.7	
	7.6 - 7.9	Slopes above Teapot Creek
	8.1 - 8.4	
	9.9 - 10.4	
	10.7 - 10.8	
	13.3 - 13.4	Bluff above Benton Reservoir
	14.5 - 14.6	Ephemeral drainages
	18.6 - 18.7	Tributary to East Fork Creek
	20.0 - 20.1	Twentymile and Teapot Hills
	21.0 - 21.2	

a = Slopes greater than 15%; determined from 1:24,000 topographic maps.

Project. It is unclear from area taxonomists (Thorne, 1987; Shultz, 1987; Marriott, 1987) where the new subspecies of milkvetch might be located, although the species itself is scattered over four states with the closest known population on red clay hills about 15 miles west of the plant site.

3.3.3 Elk Basin Project

Soils. Soils along the proposed Elk Basin Trunk Pipeline are formed in alluvium, aeolian sand deposits and residuum. Bedrock in most of the area is shale, sandstone or limestone. Soils formed from these materials range in texture from clay to sandy skeletal. Topographically they vary from nearly level valley bottoms to fans and steep terraces. Slopes which would be traversed by the pipeline are generally less than 15 percent although a few sections are steeper and are listed in Table 3-10.

Of the approximately 178 miles of pipeline, only 30 miles have no soils-based limitations. About 25 miles have minor textural limitations, i.e., soils with one or more loamy sand horizon. About 11 additional miles are limited by more coarse soils, i.e., sandy or coarser soil and/or more than 35 percent fragments. The remaining soils have depth and/or permeability problems. About 24 miles have only low permeability and 26 miles are shallow. About 56 miles are both shallow and have low permeability and 5 miles have salinity problems. Soils in any of these categories may have an additional limitation of a high water table. Most riparian areas and many croplands, including *prime farmland* soils, are included in the latter category.

The plant site is generally level and has been mapped as two soils units ranging in texture from very fine sandy loam to sandy loam. Permeability can be a limiting factor in this area. Soils of the wellfield are highly variable in all soil factors. Slopes range from nearly level to very steep.

Vegetation. The pipeline is in the Big Horn Basin 5- to 9-, Foothills and Mountains East 15- to 19-, Foothills and Basins East 10- to 14-, Wind River Basin 5- to 9- and High Plains Southeast 10- to 14-inch precipitation zones (Soil Conservation Service, 1970) and would affect all nine vegetation or land cover types previously described. Sagebrush/grassland and desert shrub are the dominant types in the area. Major riparian areas are in the Shoshone, Greybull and Big Horn River valleys, where the pipeline would be located adjacent to existing pipeline corridors.

Two plants of special interest are known from the vicinity of the trunk pipeline route. Porter's sagebrush (*Artemisia porteri*) is a federal Category 3C plant and the Owl Creek miner's candle (*Cryptantha subcapitata*) is a Category 2 (see the glossary for definitions of categories). The population of Porter's sagebrush closest to the project is one mile south of milepost 139. The closest population of the Owl Creek miner's candle is about 8.5 miles southwest of milepost 124. In addition, the project area includes habitat that may support the many-stemmed spiderflower (*Cleome multicaulis*). While the only known Wyoming population of this federal Category 2 plant is 35 miles south of the pipeline route, there have been no systematic surveys for the species. It could occur in moist alkali soils traversed by the pipeline.

The proposed plant site and wellfield are in the Big Horn Basin 5- to 9-inch precipitation zone. The plant site is in sagebrush/grassland vegetation. The wellfield is dominated by sagebrush/grassland but includes mixed shrub and coniferous woodland on hills and ridges, riparian vegetation on Silver Tip Creek and disturbed sites.

Associated Projects. There are three major soil groups that would be

affected by the Bairoil/Dakota Pipeline from mileposts 112 to 187. The Crooks Gap-Green Mountain area (mileposts 112 - 120) and the Rattlesnake Hills (mileposts 155 - 165) are dark colored soils of mountains and mountain valleys. The area between Green Mountain and the Rattlesnake Hills has primarily light colored soils of basins, terraces and fans. North of the Rattlesnake Hills are primarily shallow soils of steep upland plains (Soil Conservation Service, 1975). This area includes almost eight miles of sensitive and steep soils (BLM, 1985a). About five miles of sensitive, steep terrain could be avoided on Green Mountain (mileposts 112 - 118.2) by using the Bairoil/Dakota Crooks Gap Option (see Appendix 4, Map 10). Although this was not the preferred alternative identified in the Bairoil/Dakota EIS, it should be reconsidered as an option since it is coincident with the Beaver Creek Project alignment for at least five miles and would avoid the Green Mountain area.

With the exception of Green Mountain and the Rattlesnake Hills, this pipeline alignment is in the High Plains Southeast 10- to 14-inch precipitation zone. The higher elevation areas are in the Foothills and Mountains Southeast 15- to 19-inch zone (Soil Conservation Service, 1970). Vegetation of this pipeline section is primarily sagebrush/grassland. Significant riparian vegetation would be crossed at the seven *perennial stream* crossings (see Section 3.5).

3.3.4 Beaver Creek Project

Soils. The Beaver Creek Trunk Pipeline would affect a variety of soils of mountain valleys, basins, terraces, fans and mountains primarily formed in residual material. Soils range in texture from fine clays to loamy skeletal. Slopes traversed by the proposed pipeline are generally less than 15 percent, although significant sections of steeper terrain would be crossed at the Beaver Divide and other mileposts listed in Table 3-10. The Beaver Divide area (about milepost 12) is also identified by Case et al. (1984) as a landslide area.

Of almost 44 miles of pipeline, only 2.4 miles have no limitations. About 14.5 miles have minor textural limitations, i.e., soils with one or more loamy sand horizon. An additional six miles are limited by more coarse soils, i.e., sandy or coarser soil and/or more than 35 percent course fragments. The remaining soils have depth and/or permeability problems. About 2 miles have only low permeability, 8.5 miles are shallow and almost 11 miles are both shallow and have low permeability.

The plant site would be located on a complex of sandy loams and fine sandy loams of less than three percent slope. The soils are very deep and well drained soils of *floodplains* (Sand Draw) and toe slopes. Soils of the wellfield are limited primarily by depth and permeability. Depending on the location of wells, construction in the wellfield could be limited by steep slopes.

Vegetation. The trunk pipeline lies within the High Plains Southeast 10- to 14-inch and Foothills and Mountains Southeast 15- to 19-inch precipitation zones (Soil Conservation Service, 1970) and would affect all nine vegetation or land cover types previously described. Sagebrush/grassland dominates the area although grassland is also well represented south of the Sweetwater River. Riparian communities are well developed along the perennial streams of the area, the Sweetwater River, Crooks Creek and Beaver Creek. Other riparian communities include Ice Slough and several small unnamed playas in the vicinity of milepost 30.

Three plants of special interest are known from the vicinity of the trunk pipeline route. They are: Porter's sagebrush (*Artemisia porteri*) a federal Category 3C species, meadow pussytoes

(*Antennaria arcuata*) a Category 2 species, and Rocky Mountain twinpod (*Physaria saximontana* var. *saximontana*) which is not federally reviewed but is considered rare by the Wyoming Natural Heritage Task Force (Marriott, 1987). Several populations of the Porter sagebrush are known to occur near the Beaver Creek Trunk Pipeline with one believed to be located on the right-of-way. The meadow pussytoes is currently known from a tributary of the East Fork of Long Creek about ten miles from milepost 15. The Rocky Mountain twinpod is known from about seven miles from milepost 15.

The plant site and wellfield are within the High Plains Southeast 10- to 14-inch precipitation zone (Soil Conservation Service, 1970). Vegetation of the proposed plant site is sagebrush/grassland. The wellfield is primarily sagebrush/grassland with mixed shrub common on small hills and ridges. Coniferous woodland and barren/badlands is also found in the field. Riparian vegetation is mapped along ephemeral drainages, Beaver Creek and Sand Draw.

3.3.5 Little Buffalo Basin Project

Soils. Soils of the Little Buffalo Basin Spur Pipeline are formed in alluvium and materials weathered from sandstone and shales. Soils formed from these materials range in texture from clayey to loamy skeletal. Topographically they vary from nearly level valley bottoms to fans and steep ridges and escarpments. Slopes traversed by the pipeline are generally less than 15 percent although short sections on the east rim of Little Buffalo Basin and other locations listed in Table 3-10 are steeper.

Of the almost 36 miles of pipeline, 13.4 miles have no limitations. About two miles have only textural limitations, including soils with one or more loamy sand horizon and very coarse soils. The remaining soils have depth and/or permeability problems. About 7 miles have only low permeability, 3.5 miles are shallow and 6 miles are both shallow and have low permeability. The latter includes about 0.5 miles with an additional salinity problem. The remaining three miles have low permeability and high salinity, but are not rated as shallow.

The proposed plant site is on gently sloping soils of a fan near the west side of the basin. Both soils of the association are well drained loams with moderate permeability formed in alluvial and *loess* material. The wellfield soils range from loamy soils with no limiting characteristics to shallow, clay and saline soils with low permeability. The interior of the basin, which supports most of the wellfield activity, is primarily gently sloping, except for steeper slopes near ephemeral drainages.

Vegetation. The Little Buffalo Basin Project area lies within the Big Horn Basin 5- to 9-inch and Foothills and Basins East 10- to 14-inch precipitation zones (Soil Conservation Service, 1970). Construction of the pipeline would affect seven vegetation or land cover types mapped for the area. They are: sagebrush/grassland, desert shrub, coniferous woodland, riparian, cropland, barren/badlands and disturbed areas. Sagebrush/grassland and desert shrub are the dominant types accounting for 56 and 24 percent of the proposed right-of-way vegetation, respectively. About 1.3 miles of coniferous woodland, mostly occupying steep slopes or ridges, would be traversed.

The spur pipeline route parallels the riparian zone of Gooseberry Creek for several miles. While most of the riparian vegetation crossed in this drainage is the greasewood sub-type, the pipeline route does intersect tree/shrub and shrub/herb mosaics. At about milepost 19 the Proposed Action route was modified to avoid a livestock reservoir which has developed into a cattail marsh. At mile-

post 21 the pipeline would pass through the Killifish Riparian Exclosure, a riparian area that is fenced from livestock for demonstration purposes. Although it would traverse the exclosure, the pipeline would be located adjacent to the highway right-of-way on a terrace above the riparian zone.

Populations of Evert's water parsnip, *Cymopterus evertii*, a federal Category 2 plant, are found less than 1.5 miles from milepost 5 of the Little Buffalo Basin Spur Pipeline. The rocky area near milepost 8 of the pipeline route appears to be suitable habitat for the species.

The plant site and wellfield are in the Foothills and Basins East 10- to 14-inch precipitation zone (Soil Conservation Service, 1970). Vegetation of the proposed plant site is sagebrush/grassland. The wellfield is predominately sagebrush/grassland with desert shrub in saline upland sites, coniferous woodland on some of the ridges surrounding the basin, and riparian vegetation on Little Buffalo Creek and its tributaries.

3.3.6 Salt Creek Project

Soils. The Salt Creek Spur Pipeline, plant and wellfield would affect two general types of soils. These soils are formed in residuum, alluvium and slopewash alluvium from shale which may be salt or alkali affected. Salt precipitated at the surface in drainages is common throughout the area. Most of the soils formed from these materials are fine, although small areas are moderately coarse textured. Topographically they vary from gently sloping to steep slopes of ridges, hillslopes and fans. Most slopes traversed by the pipeline would be generally less than 15 percent although a few sections are steeper. In addition to small hills or minor incised ephemeral drainages, two areas of steep slopes were identified on the spur pipeline route. One is at mileposts 0.5 - 1.2 where a rock outcrop soil complex occurs with 10 to 40 percent slopes. The other is at milepost 3.3.

Of the approximately nine miles of proposed pipeline, less than a mile has no limitations. The remaining soils have depth and/or permeability limitations. About 1 mile has only low permeability, 0.8 miles are shallow and 6.5 miles are shallow with low permeability.

The plant site would occupy a clay loam soil complex which ranges in slope from 3 to 30 percent and includes gullied land. The soils of the complex are well drained but some areas are shallow with low permeability and low water holding capacity. While the proposed plant site is currently gently sloping, the potential for runoff is rapid and water erosion high. Wellfield soils range from nearly level, fine soils with poor permeability to rock outcrops of 40 percent slope. The major limiting features are depth and permeability. The project area is located within the Salt Creek and Castle Creek sensitive drainages (BLM, 1984a).

Vegetation. The Salt Creek Project would be within the High Plains Southeast 10- to 14-inch precipitation zone (Soil Conservation Service, 1970). The project would affect five vegetation types: desert shrub, grassland, sagebrush/grassland, riparian and disturbed areas. Desert shrub is the dominant type accounting for over 60 percent of the proposed right-of-way. A short grass grassland is well represented in the area.

Vegetation of the proposed plant site is desert shrub. The wellfield is desert shrub, grassland, sagebrush/grassland and riparian along Salt Creek, Castle Creek and their ephemeral tributaries.

There are no plants of special interest known from the Salt Creek Project area.

Associated Projects. There are two major soil groups that would be affected by the Bairoil/Dakota Pipeline from mileposts 187 to 221. The soils are both dark and light colored soils of upland plains, terraces and fans formed in residual material on steep uplands (Soil Conservation Service, 1975). In this area there are almost seven miles of sensitive and steep soils (BLM, 1985a).

This pipeline alignment is in the High Plains Southeast 10- to 14-inch precipitation zone. Vegetation of this pipeline section is primarily sagebrush/grassland in the south and desert shrub, sagebrush/grassland and grassland in the north. Riparian vegetation at numerous ephemeral drainages and one perennial stream, Middle Fork of Casper Creek, would be affected.

3.3.7 Beaver Creek Alternative

Soils. The Beaver Creek Alternative alignment would include soils described above for the Beaver Creek Trunk Pipeline and the Elk Basin Trunk Pipeline. The alignment section that connects the Beaver Creek Field to the Elk Basin Trunk Pipeline would affect three major soil types: soils of mountain valleys, basins and foothills. These soils are primarily formed in residual material and range in texture from clayey to loamy skeletal. Slopes crossed by the proposed route between the Beaver Creek Field and the Elk Basin Trunk Pipeline are generally less than 15 percent slope although significant sections of steeper terrain would be traversed crossing bluffs above Highway 20 - 26, Badwater, Bridger and Cottonwood creeks (see Table 3-10).
Order 3 survey data are available for about half of this alternative pipeline route. The remainder of the area (i.e., most of the Wind River Indian Reservation) has either preliminary survey data or only reconnaissance survey data (Dillahunty, 1988). Most of the soils which would be disturbed during pipeline construction have at least some limiting feature. About ten miles have minor textural limitations, i.e., soils with one or more loamy sand horizon. An additional 3.5 miles are limited by more coarse soils, i.e., sandy or coarser soil and/or more than 35 percent coarse fragments. The remaining soils have depth and/or permeability problems. About 3.2 miles have only low permeability, about 11 miles are shallow and 7.4 miles are shallow with low permeability. Because the southern option would traverse more steep, rockier terrain and less creek bottom terrain than the northern option, it has about one mile less coarse soils and about a mile more shallow soils with low permeability.

Vegetation. The Beaver Creek Alternative leaves the Beaver Creek Field and joins the Elk Basin Trunk Pipeline in the High Plains Southeast 10- to 14-inch precipitation zone. The central part of the alternative alignment is in the Wind River Basin 5- to 9-inch precipitation zone (Soil Conservation Service, 1970).

The alternative will affect four vegetation types: sagebrush/grassland, desert shrub, grassland and riparian. Sagebrush/grassland dominates the area. Riparian communities are well developed along the perennial streams of the area including Bridger, Badwater and Poison creeks.

Two plants of special interest, Porter's sagebrush (*Artemisia porteri*) and the Owl Creek miner's candle (*Cryptantha subcapitata*), are known from the vicinity of the alternative pipeline route. The population of Porter's sagebrush closest to the project is about one mile south of the route near mileposts 38 - 40. The closest population of the Owl Creek miner's candle is about seven miles north of milepost 28.

3.3.8 Frontier/Casper Alternative

Soils. The Frontier Access Section of this alternative would affect two general types of soils. These soils are very deep, well-drained, nearly level to gently sloping soils of stream terraces and alluvial fans, very deep, excessively-drained soils in sand hills and moderately deep and very shallow well-drained soils of undulating or rolling plains. Soils can also be strongly alkaline (Soil Conservation Service, 1982). In addition to small hills or minor incised ephemeral drainages, two areas of steep slopes were identified on the Frontier Access Section. One is the ridge above South Fork Creek (milepost 5.3) and the other is a dissected bench at mileposts 9.3 - 9.8. There are about 2.5 miles of soils with limiting conditions (BLM, 1984b).

In the Casper Section of this alternative, the soils are deep and well-drained soils of floodplains and terraces and upland soils formed in interbedded, mixed or uniform parent material. The upland soils can be shallow to deep and well drained to excessively drained (Soil Conservation Service, 1985). Steep slopes are crossed at several ephemeral drainages. One steep area to be traversed would be on the slopes above Teapot Creek (mileposts 6.5 to 10.8) (see Table 3-10).

Of the almost 40 miles of Casper Section alternative alignment, 8.6 miles have no limitations. The remaining soils have depth and/or permeability limitations. About 0.2 miles have only low permeability, 8.2 miles are shallow and 9.6 miles are shallow with low permeability. About 13.4 miles have minor textural limitations, i.e., soils with one or more loamy sand horizon. The project area is located within the Teapot Creek, Salt Creek and Castle Creek sensitive drainages (BLM, 1984a).

Vegetation. The Frontier Access Section is within the Green River and Great Divide Basin 7- to 9-inch precipitation zone. The vegetation is primarily sagebrush/grassland vegetation with some desert shrub and riparian vegetation (mostly greasewood subtype) in the western part of the section.

The Casper Section lies within the High Plains Southeast 10- to 14-inch and Northern Plains 10- to 14-inch precipitation zones (Soil Conservation Service, 1970). The Casper Section would affect six vegetation types: desert shrub, grassland, sagebrush/grassland, riparian, cropland and disturbed areas. Desert shrub is the dominant type near the Salt Creek Field, with sagebrush/grassland and grassland dominating the route in its central and southern portions, respectively. The principal riparian areas which would be disturbed are Teapot Creek and Casper Creek.

There are no plants of special interest in either section of this alternative.

3.3.9 Exxon Alternative CO_2 Supply

Soils. Soils of the Shute Creek Phase II Plant site are formed by aeolian deposition, alluvial erosion and alluvial deposition on shale, siltstone and sandstone parent material. These processes have produced soils ranging from calcareous sands and loamy sands on partially stabilized, hummocky dunes; saline-alkaline soils with gravelly surfaces, and deep, silty, strongly saline-alkaline soils. Clayey, salt-affected alluvial soils are also found on terraces of Shute Creek. The soils of the plant site are all nearly level to gently sloping. Sandy textures and saline-alkaline conditions along with limited precipitation would be the major limiting factors for *reclamation*.

Soils of the feed gas pipeline are similar to plant site soils along the southern portion of the line. Nearer to the wellfield, side ridges are comprised of undulating to steep convex slopes and crests. Soils are moderately deep and well drained and reflect the loamy or clayed textural characteristics of the interbedded sandstones, siltstones and shales that form them. These soils generally have poor site rehabilitation potential because of slope, depth to bedrock and clayey textures. Their potential improves somewhat on the flatter slope areas.

Vegetation. The Shute Creek Plant site and most of the feed gas pipeline would be constructed within the Green River and Great Divide Basin 7- to 9-inch precipitation zone. The northern part of the pipeline and the wellfield are in the Foothills and Basins West 10- to 14-inch zone (Soil Conservation Service, 1975). The plant construction would affect four vegetation types: sagebrush/grassland, the greasewood sub-type of riparian, grassland and desert shrub. Vegetation types of the feed gas pipeline are the same as the plant site types with additional riparian vegetation including meadow and willow communities and floodplains and subirrigated areas that have been developed as pasture or hayland (cropland).

3.3.10 No Action Alternative

The affected environments for soils and vegetation for the No Action Alternative are the same as those described for the Proposed Actions in Section 3.3.2 through 3.3.6.

3.4 AGRICULTURE

3.4.1 Introduction

Agriculture in the project areas is primarily livestock grazing with some crop production. Federal and most state grazing land is divided into allotments which may or may not contain private lands. Table 3-11 lists grazing allotments that would be crossed by the pipelines or are within existing oil field boundaries, the category of allotment, animal unit months (*AUMs*) licensed and their season of use.

Cropland includes both irrigated and non-irrigated production of row and forage crops. Table 3-12 is a summary of planted cropland acreage for the Proposed Action project counties. Almost all of the cropland in the study area is on private land. There is currently no cropland within any of the wellfield boundaries that could be directly affected by construction activities.

The Soil Conservation Service classifies several soil units in the project areas as prime farmland if the required agricultural practices are employed (Soil Conservation Service, 1983a).

3.4.2 Fontenelle Project

Agriculture in the Fontenelle Project area is primarily livestock grazing divided among four large grazing allotments. East of the Green River, AUMs are primarily allocated to sheep. West of the river, use has been about equally distributed between sheep and cattle (BLM, 1982d;, BLM, 1983a; BLM, 1985b). Crop cultivation is limited to land which is usually flooded by Fontenelle Reservoir. The area has been farmed since the reservoir water level was lowered for dam repair.

3.4.3 Elk Basin Project

Livestock grazing is the principal agricultural activity along most of the Elk Basin Trunk Pipeline route. The pipeline would traverse 38 grazing allotments in five BLM resource areas. Cattle ranching dominates in most of the resource areas although sheep are found throughout the pipeline route.

Table 3-11. Forage Statistics for Grazing Allotments by Project and BLM Resource Area.

Project	Resource Area	Allotmen Number	Category (a)	Acres (b)	Licensed AUMs (c)	Average AUMs Per Acre	Kind of Livestock (d)	Season of Use
Fontenelle	Kemmerer (e)	1112		12,555	1,272	0.10	C	7/1-9/20
							S	5/15-12/31
		1113		271,170	11,493	0.04	C	5/8-10/31; 5/16-9/30; 6/1-9/30
							S	4/26-11/30; 5/1-5/31 6/1-7/15; 5/20-7/15 9/29-10/9; 6/26-6/28
		1306		257,313	30,924	0.12	S	12/1-11/30
							C	5/1-10/31
	Green River (f)	18 Mile		247,314	3,564	0.08	C	5/16-9/30; 10/1-12/15
					15,430		S	5/1-5/5; 10/1-12/14
		Lombard		94,802	1,501	0.07	C,H	5/1-1/31
					5,143		S	5/1-1/31 + trailing
	Pinedale, South LaBarge Common	2005		100,309	10,076	0.10	C	5/1-10/15
Elk Basin	Cody (g,h)	0666	M	6,640	755	0.11	C,S	4/15-5/30
		1003	M	19,397	1,143	0.10	C	5/1-12/30
		1060	I	56,849	3,885	0.07	S	4/10-6/14;6/1-6/30 10/1-12/18
							C	4/10-5/31
		1061	C	5,842	200	0.03	C	5/15-9/30
		1080	I	54,600	4,463	0.08	C	4/30-6/30; 11/1-2/6
		1086	M	4,775	309	0.06	S	3/5-5/15; 9/1-11/1
	Grass Creek (i)	0508	I	124,727	7,271	0.06	C	4/16-1/21
							S	11/1-9/15
		0509	I	96,203	7,663	0.08	C	5/1-10/31
							S	5/5-6/20; 10/10-2/19
		0512	C	11,793	726	0.06	C	5/1-9/30
		0549	C	327	27	0.08	S	6/1-6/10
		0674	C	11,270	1,092	0.10	S	5/10-7/9; 11/1-2/2
	Washakie (h,j)	0048	I	24,460	2,075	0.08	C	11/22-4/15
							S	11/15-3/14
		0501	I	15,084	2,957	0.20	S	1/1-6/10
							C	3/1-10/15
		0562	I	11,641	1,934	0.17	C	4/1-5/31; 11/5-12/13
		0571	I	4,071	503	0.12	C	10/20-12/31
		0591	I	5,027	476	0.09	S	10/21-1/22
		0603	C	2,280	431	0.19	C	11/1-12/30
		2513	I	242	30	0.12	N.D.	N.D. (l)
		2514	I	8,756	473	0.05	N.D.	N.D.
		2542	I	440	96	0.22	N.D.	N.D.
		2543	I	698	156	0.22	N.D.	N.D.
		2547	I	2,213	396	0.18	H	3/1-10/31
							S	6/1-11/30
							C	8/1-2/28
	Lander (k)	1312	I	26,372	2,820	0.11	C	2/15-6/15; 9/1-12/15
							H	3/1-2/28
		1315	C	1,335	108	0.08	C	5/1-5/15
		1316	C	2,873	170	0.06	C	1/1-2/28
		1322	I	4,664	726	0.16	H	5/1-2/28
							C	10/15-12/31
		1325	I	7,240	272	0.04	S	3/1-5/10
		1332	M	3,247	159	0.05	C,H	6/1-9/30
		1337	C	6,599	125	0.02	C	3/1-2/28
		1353	M	8,694	416	0.05	C,S,H	3/1-2/28
		1355	M	8,941	673	0.08	C,S	4/1-6/5
		1357	M	536	32	0.06	C	6/15-7/14

Table 3-11. Continued.

Project	Resource Area	Allotmen Number	Category (a)	Acres (b)	Licensed AUMs (c)	Average AUMs Per Acre	Kind of Livestock (d)	Season of Use
	Platte River (h,m)	0006	I	1,638	125	0.08	S	12/15-2/27
		0007	I	2,176	229	0.11	S	12/15-2/27
		0008	M	1,200	16	0.01	S	5/1-5/30
		0013	I	9,513	1,478	0.16	S	5/16-10/15
		0018	I	17,955	2,597	0.14	C	All year
		0037	I	36,855	3,734	0.10	S	All year
		0066	I	14,560	1,232	0.11	S	11/1-6/30
					308		C	11/1-6/30
		0130	M	2,246	1,038	0.46	C	All year
		0134	M	4,675	641	0.14	C	All year
		0148	M	24,608	3,193	0.13	C	All year
		0523		9,362	1,270	0.14	S	All year
Beaver Creek	Lander (n)	1703	I	98,103	13,238	0.14	C	5/1-11/15
					884		S	6/14-10/31
		1704	M	17,264	1,956	0.11	C	4/3-11/15
							H	4/1-12/15
		1707	I	2,300	183	0.08	C	10/1-12/30
		1715	M	549	14	0.03	H	12/16-4/30
							S	6/29-7/7
		1801	I	78,402	8,321	0.11	S	11/25-4/10; 11/10-12/31
					503		C	5/1-11/30
		1802	I	14,185	1,163	0.08	C	6/1-10/15
		1805	I	6,701	734	0.11	C	5/1-10/15
		1812	I	16,556	516	0.03	C	5/1-10/31
		2001	I	308,087	35,992	0.15	C	5/1-12/31
					11,348		S	3/1-11/30
		2004	I	6,664	651	0.10	C	5/15-4/30
		2011	I	1,874	296	0.16	C	4/1-5/15
		2012	M	5,028	377	0.07	C	4/1-4/30
		2013	I	13,040	1,727	0.13	C	5/1-11/15
		2023	M	654	67	0.10	C	10/1-10/31
Little Buffalo Basin	Grass Creek (i)	0508	I	124,727	7,271	0.06	C	4/16-1/21
							S	11/1-9/15
		0545	I	6,570	982	0.15	C	5/15-12/31
		0564	M	2,466	562	0.23	C	Flexible
		0579	I	15,538	2,316	0.15	C	4/15-6/20; 7/1-12/31
		0594	M	3,375	567	0.17	C	5/8-8/6
		0604	M	56,192	6,600	0.12	C	12/16-3/31
							S	11/14-4/30
		0605	I	66,004	4,878	0.12	C	4/1-6/20; 10/16-2/25
					2,900		S	3/1-7/31; 9/3-11/3
							H	12/1-6/30
		0623	C	8,669	649	0.07	C	4/1-4/30; 11/1-1/31
		2510 (h)	I	2,175	347	0.16	C	N.D.
Salt Creek	Platte River (h,m)	SDW (0)		48,180	5,000	0.10	C,S	30 Days
		0039	I	5,760	384	0.13	S	All year
					376		C	
		0115	M	44,389	566	0.02	S	All year
					282		C	
		0118	M	3,823	262	0.07	C	9/15-11/14
		0153		5,691	999	0.18	S	12/1-4/30
		0154	M	1,400	63	0.05	C	5/1-6/30

Table 3-11. Continued.

Project	Resource Area	Allotmen Number	Category (a)	Acres (b)	Licensed AUMs (c)	Average AUMs Per Acre	Kind of Livestock (d)	Season of Use
Beaver Creek Alternative	Lander (k)	1324	I	29,697	2,775	0.09	C, S, H	3/1-2/28
		1325	I	7,240	272	0.04	S	3/1-5/10
		1330	M	6,321	420	0.07	S	3/19-4/20
							C	8/1-12/31
		1333	I	16,393	1487	0.09	C, S	11/1-5/10
		1335	I	8,598	912	0.11	C	12/1-3/31
		1339	I	4,856	490	0.10	C	12/1-2/28
		1351	I	3,405	303	0.09	C	4/7-6/6
		1404	I	3,686	397	0.11	C, H	11/1-6/20
		1406	M	20,026	817	0.04	C	11/1-4/30
		1407	i	47,025	3962	0.08	C	10/10-6/15
		1801	I	78,402	8,321	0.11	S	11/25-4/10; 11/10-12/31
					503		C	5/1-11/30
		1805	I	6,701	734	0.11	C	5/1-10/15
Frontier/ Casper	Kemmerer (e)	1306		257,313	30,924	0.12	S	12/1-11/30
							C	5/1-10/31
Alternative	Green River (f)	3018	M	2,088,247	213,106	0.10	C, S	All year
					5,143			
	Platte River (h,m)	0039	I	20,998	3,237	0.15	S	All year
		0068	M	14,942	2,037	0.14	C	All year
		0082	M	6,105	1305	0.21	S, C	All year
		0096	M	4,298	919	0.21	S, C	All year
		0115	M	28,262	4146	0.15	S, C	All year
		0136	M	3,240	760	0.23	S	10/15-12/15

(a) M = maintain; no significant problems.
I = improve; not satisfactory in terms of productivity, condition or management.
C = custodial; little opportunity for economic improvement.
(b) Total federal, state and private acreage in allotment unless noted.
(c) Total federal, state and private AUMs unless noted.
(d) C = cattle; S = sheep; H = horses.
(e) Kemmerer Resource Management Plan, Record of Decision (BLM, 1985c).
(f) Grazing allotment management plans, 1983 (BLM, 1982d and BLM, 1983a) and Salt Wells Pilot Butte Grazing EIS (BLM, 1983b).
(g) File data and draft Resource Management Plan (BLM, 1988).
(h) Acreage and AUMs for public lands only.
(i) Source: Grass Creek Grazing DEIS (BLM, 1982b) updated with BLM allotment files.
(j) Source: Washakie Resource Management Plan DEIS (BLM, 1986c).
(k) Source: Lander Grazing Supplement FEIS, Gas Hills Area (BLM, 1986a).
(l) Not determined.
(m) Source: Platte River Resource Management Plan DEIS (BLM, 1984a) and file data.
(n) Source: Green Mountain Grazing DEIS (BLM, 1982c) and BLM files.
(o) Stock Driveway.

Table 3-12. Crop Statistics for Project Counties. (a)

County	Wheat	Barley	Oats	Dry Beans	Sugar Beets	Corn	Hay	Total
	ACRES PLANTED							
Big Horn	1,600	26,600	7,500	4,200	13,700	6,800	30,500	90,900
Fremont	1,000	24,400	9,100	2,400	100	900	82,000	119,900
Hot Springs	100	1,500	1,500	0	250	100	18,000	21,450
Lincoln	700	20,700	1,700	0	0	0	76,500	99,600
Natrona	1,500	100	3,300	0	0	200	22,500	27,600
Park	1,100	35,800	5,100	6,100	12,000	1,400	35,500	97,000
Sweetwater	0	500	1,600	0	0	0	16,500	18,600
Washakie	200	16,400	1,900	300	10,250	2,300	12,500	43,850

a = Source: Wyoming Agricultural Statistics, 1986.

Produced water presently discharged from the existing Elk Basin Field to Silver Tip Creek is currently used to water livestock in the area.

The majority of cropland along the proposed Elk Basin Pipeline is in the Shoshone River drainage, the Greybull River valley and the Bighorn River valley. Sugar beets, malt barley, alfalfa, beans, oats, wheat, corn for silage, and other forage and seed crops are the principal irrigated crops. All area cropland is irrigated. Water is in the main canals continuously from mid-April to mid-October.

Cropland traversed in the Shoshone drainage is irrigated as part of three irrigation units: the Garland and Willwood divisions of the Bureau of Reclamation Shoshone Project and the Elk Water Users Association area. Main diversions that would be crossed by the pipeline are the Frannie Canal, Lateral D, the Sidon Canal, the Elk Canal (a.k.a. Elk-Lovell), the Penrose Drainage Ditch and the Willwood Canal Lateral (Bureau of Reclamation, 1972; Shoshone - Heart Mountain Irrigation District, 1988; Willwood Irrigation District, 1988; Hopkins, 1988). Several small ditches would also be traversed in each of these areas.

The Greybull Valley Irrigation District controls irrigation on the Greybull River in the vicinity of the town of Burlington. The major diversions which would be crossed by the Elk Basin Pipeline are the Bench Canal, Farmer's Canal and the Bank Lateral. The Maller Ditch, Tatman Canal, St. Joe Canal and many smaller ditches would also be crossed one or more times (Hoyt, 1988).

Both the Bluff Canal Irrigation District and Upper Hanover Irrigation District operate along the Bighorn River near Neiber. The major diversions which would be crossed are the Upper Bluff and Bluff canals north of the river and the Upper Hanover Canal south of the river (Cooper, 1988).

Associated Projects. The Bairoil/Dakota Pipeline would affect grazing allotments in the BLM Lander and Platte River resource areas. The alignment would cross about 0.4 miles of cropland along the Sweetwater River.

3.4.4 Beaver Creek Project

Livestock production, principally *cow-calf operations*, is the major agricultural activity of the area. Livestock use Beaver Creek as a water source within the field. Small areas of cropland, usually used for hay production, are scattered along perennial creeks in the area, i.e., the Sweetwater River (milepost 25) and Crooks Creek (milepost 39).

3.4.5 Little Buffalo Basin Project

Irrigated cropland is common in the Gooseberry Creek valley and the spur pipeline would cross almost 3 miles of irrigated farmland and 2.3 miles of prime farmland.

Hay and sugar beets are the most common crops watered from a series of private irrigation ditches. The spur pipeline would cross five of these ditches (the Holder, Homestead, Murphy, Quartz and Enlarged Quartz ditches) one or more times. Produced water presently discharged from the Little Buffalo Basin Field enters Little Buffalo Creek. Since natural streamflow available for irrigation does not always meet demand, this surface discharge of produced water is considered by most to be a benefit to agriculture (Roseberry, 1988; Rhodes, 1988).

Sugar beet hauling is a major agricultural activity with hauling to stockpiles and rehauling to the Worland processing facility beginning in early September and continuing to the end of the year. Gooseberry Creek sugar beets are stockpiled primarily at a

station south of Worland (Thompson, 1988).

Livestock grazing is the other principal agricultural activity of the area. Cattle dominate on eight of the nine area grazing allotments.

3.4.6 Salt Creek Project

Agriculture in the project area is predominately sheep ranching. About two-thirds of the AUMs allocated on the four BLM grazing allotments, which would be affected by the spur pipeline, are for sheep. The spur pipeline would also traverse a designated stock driveway. Livestock growers currently use produced water from the Salt Creek Field to water livestock (Fifield, 1988). Dry farming wheat was attempted in the area but abandoned several years ago (Arnold, 1988).

Associated Projects. The Bairoil/Dakota Pipeline would affect grazing allotments in the Platte River Resource Area but no cropland would be affected.

3.4.7 Beaver Creek Alternative

Agriculture along the Beaver Creek Alternative route is primarily cattle ranching. Federal, state and private land is divided among 12 grazing allotments (see Table 3-11). The remainder of the route (about 18 miles) is on the Wind River Indian Reservation and is not BLM controlled grazing. The Beaver Creek Alternative alignment would also affect the agricultural environment described for the Beaver Creek Trunk Pipeline and the Elk Basin Trunk Pipeline from mileposts 0 to 130. The latter would include all of the cropland described for the Elk Basin Project.

3.4.8 Frontier/Casper Alternative

Agriculture on both the Frontier Access and Casper sections of this alternative is a combination of cattle and sheep grazing. Within the Salt Creek Field, livestock operations use produced water discharged from the oil field operations. About 4.6 acres of cropland would be crossed along Casper Creek.

3.4.9 Exxon Alternative CO_2 Supply

Agriculture at the Shute Creek Plant site is currently cattle and sheep grazing. The feed gas pipeline would cross four grazing allotments in the Kemmerer and Pinedale resource areas. Cropland, consisting of pasture and haylands, would be crossed along area streams.

3.4.10 No Action Alternative

The agricultural affected environment for the No Action Alternative is the same as previously described for the Proposed Actions in Sections 3.4.2 through 3.4.6.

3.5 WATER RESOURCES

3.5.1 Introduction

This section describes the water resources which could be affected by construction of the Proposed Actions or project alternatives. The amount, temporal and spatial distribution and quality of Wyoming's water resources depends on several interactive factors. Of primary importance are climate, topography and land use. Secondary factors include soils and vegetation because they affect the amount of run-off versus infiltration and stored water. Low soil permeability and shallow soils with limited water holding capacity are significant

limiting features of many Wyoming soils.

This section presents stream classifications based on criteria established by the Wyoming Department of Environmental Quality (WDEQ), entitled "Quality Standards for Wyoming Surface Waters". The WDEQ rating system includes four classes, as listed below:

- o <u>Class I</u>: Those surface waters which shall be maintained at their existing quality in which no further water quality degradation by point source discharge will be allowed;

- o <u>Class II</u>: Those surface waters, other than those classified Class I, which are determined by the Wyoming Game and Fish Department to be presently supporting game fish or have the hydrologic and natural water quality potential to support game fish;

- o <u>Class III</u>: Those surface waters, other than those classified as Class I, which are determined by the Wyoming Game and Fish Department to be presently supporting non-game fish or have the hydrologic and natural water quality potential to support non-game fish;

- o <u>Class IV</u>: Those surface waters, other than those classified as Class I, which are determined by the Wyoming Game and Fish Department to not have the hydrologic or natural water quality to support fish.

The Wyoming Game and Fish Department recently updated a similar stream fishery classification map for waters of the state. The department utilized the following five classes to rate the fishery quality of streams:

- o <u>Class 1</u>: Premium trout waters--fisheries of national importance.

- o <u>Class 2</u>: Very good trout waters--fisheries of statewide importance.

- o <u>Class 3</u>: Important trout waters--fisheries of regional importance.

- o <u>Class 4</u>: Low production trout waters--fisheries of local importance, but generally incapable of sustaining substantial fishery pressure.

- o <u>Class 5</u>: Very low production waters--often incapable of sustaining a trout fishery.

3.5.2 Fontenelle Project

The Fontenelle Project area is in the Green River Basin. The region is composed of tablelands dissected by gullies, canyons and broad stream valleys. The gas gathering system would cross two perennial streams, including a crossing of the Green River at milepost 9 (Table 3-13). The project would also cross *intermittent* and ephemeral streams at 15 locations. Water quality and flow data for the Proposed Actions and alternatives are summarized in Table 3-14. Water quality of the Green River below Fontenelle Reservoir is characterized by moderate *total dissolved solids (TDS)* concentrations, low to moderate turbidity, and moderate alkalinity. pH values are moderately alkaline and exhibit no distinct patterns or seasonal trends.

Because of the potential for acid precipitation resulting from Exxon's LaBarge Project *emissions*, high mountain lakes in the Bridger Wilderness area were evaluated for potential effects of acid precipitation from the Riley Ridge Natural Gas Project (BLM, 1983c) The lakes in the area occur at 9,000 to 11,000 feet, have granitic substrates and are primarily fed by snowmelt. The pH of these lakes is slightly less than neutral and the

Table 3-13. **Perennial Streams Crossed by Proposed Action and Alternative Pipelines.**

Project	Stream	Milepost	Water Quality Classification (a)	Wyoming Game and Fish Department Fishery Classification
Fontenelle	Slate Creek	3W	II	5
	Green River	9	I	1
Elk Basin	Bitter Creek	20	II	3
	Shoshone River	21	II	3
	Whistle Creek	28	II	4
	Dry Creek	40	II	4
	Greybull River	44	II	4
	Willow Creek	47	IV	5
	Middle Fork, Fifteenmile Creek	74	IV	5
	Bighorn River	87	II	4
	Kirby Creek	117,119	II, IV (b)	4
	West Kirby Creek	111	II	4
	West Bridger Creek	121	II	4
	Bridger Creek	132	II	4
Beaver Creek	Sweetwater River	25	II	3
	Crooks Creek	40-42	II	3
Little Buffalo Basin	Buffalo Creek	8	IV	4
	Gooseberry Creek	13-15	II	4
Beaver Creek Alternative	Bridger Creek	54	II	4
Frontier/Casper Alternative	Casper Creek	39	II	4
Bairoil/Dakota Associated Pipeline	Sweetwater River	134	II	4
	Middle Fork Casper Creek	181	III	---
	Sheep Creek	115	II	---
	W. Cottonwood Creek	119	---	4
	M. Cottonwood Creek	120	---	4
	Dry Creek	150	---	4
	Poison Spider Creek	168	IV	---
Exxon Alternative CO2 Supply	Dry Piney Creek		---	4
	LaBarge Creek		---	3
	Fontenelle Creek		--- (c)	3
	Slate Creek		II	5

a = Classification from the Wyoming Department of Environmental Quality.
b = Kirby Creek's water quality classification is II above the Kirby Creek Field, and IV below.
c = National Park Service potential wild and scenic river (BLM, 1982b).

Table 3-14. Water Quality Data from Streams in the Project Areas. (a)

Project	Stream	Flow (cfs)		TDS (mg/l)		SS		pH		Alkalinity	
		max	min	max	min	max	min	max	min	max	min
Fontenelle	Green River	14,000	296	357	150	20	1	9	8	180	100
Elk Basin	Bitter Creek	438	10	1,410	356	N/A	N/A	9	8	330	130
	Shoshone River (near Garland)	5,780	10	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Shoshone River (above Dry Creek near Cody)	6,400	173	1,370	124	N/A	N/A	9	7	310	61
	Whistle Creek	1,230	0	7,280	234	N/A	N/A	9	7	700	82
	Dry Creek	492	5	2,880	637	N/A	N/A	9	8	320	8
	Greybull River	1,200	8	1,090	180	N/A	N/A	9	8	700	90
	Bighorn River	6,830	45	1,000	385	N/A	N/A	9	8	300	110
Beaver Creek	Sweetwater River	3,340	6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Frontier/Casper Alternative	Casper Creek	175	4	N/A	N/A	N/A	N/A	9	8	N/A	N/A
Bairoil/Dakota Alternative	Sweetwater River	2,900	2.4	N/A	N/A	242	4	8.6	7.5	180	82

a= Source: U.S. Geological Survey, 1978-1987.
N/A = Data Not Available

buffering capacity is small (BLM, 1983c).

The proposed Fontenelle Plant site would be constructed near Shute Creek, an intermittent stream designated Class IV by the Wyoming Department of Environmental Quality. The main stem of Shute Creek runs through the northeastern corner of the 160-acre area which would include the 40-acre plant site. The north drainage, a tributary to Shute Creek, traverses the southern border of the area. The mainstream of Shute Creek flows in a deeply incised channel cut into sparsely vegetated sagebrush hills. Water quality data are not available for Shute Creek but it is probably poor as a result of high sediment loading from weathered sediments (Exxon, 1985).

The 100-year flood peak is estimated at 1,347 cubic feet per second (cfs) for the main stem of Shute Creek and 600 cfs for the north drainage. Conservative estimates of the 100-year floodplains of both drainages indicate that more than half of the 160-acre area is within the 100-year floodplain.

Groundwater resources in southwestern Wyoming are controlled chiefly by climate, geology and topography. Recharge to shallow groundwater sources is by seepage, infiltration and percolation from runoff, precipitation and streamflow. Depletion is by discharge to streams and lakes and from production wells. Long-term observations of water levels in wells indicate recharge and discharge are in balance and significant depletions have not occurred (Exxon, 1985). Groundwater quality ranges from very poor to excellent.

Groundwater of good quality can occur in the Madison and Wasatch formations and provides domestic and municipal water for several communities. The Madison Formation can yield relatively large amounts of water with relatively low dissolved solids compared to other aquifers in the area. Sandstone and conglomerate members of the Wasatch Formation can yield small to moderate amounts of water, commonly containing 500 to 1,000 milligrams per liter of dissolved solids. In general, groundwater in the Green River Basin becomes more mineralized with increased depth.

Information from production test wells at Exxon's Shute Creek Plant site indicate that groundwater resources occur in aquifers of the Green River and Wasatch formations. These wells are at 800 and 1,500 feet. Water quality is generally fair to poor in both formations. Most wells in the Shute Creek vicinity produce water from the Green River Formation with a few shallow wells in the Fort Bridger Formation or alluvium. The nearest well with a permanent water right is about two miles from the Shute Creek Plant site.

3.5.3 Elk Basin Project

The project area is drained by the Bighorn River and Powder River subbasins, tributaries to the Missouri River Drainage System. The Elk Basin Trunk Pipeline would cross 12 perennial streams at 13 locations, including the Shoshone River at milepost 21, the Greybull River at milepost 44 and the Bighorn River at milepost 87 (see Table 3-13). In addition, the pipeline would cross intermittent and ephemeral streams at 150 locations.

Water quality varies along the proposed pipeline route. Water quality in this area is generally characterized by high concentrations of *total suspended solids (TSS)* and TDS. Sediment from erosion is considered to be the most serious water quality problem. The trunk pipeline would cross three designated sensitive drainages (Badwater Creek, Alkali Creek and Wallace Creek) (BLM, 1984a). The pipeline would also cross the Kirby Creek Watershed, designated highest priority for watershed project planning in the BLM's Washakie Resource Area (BLM, 1986c).

Associated Projects. From mileposts 112 to 185, the Bairoil/Dakota Pipeline would cross seven perennial streams, four of these (Sheep Creek, West Cottonwood Creek, Middle Cottonwood Creek and the Sweetwater River) would be at existing pipeline crossings. Water quality data for the Sweetwater River are presented in Table 3-14.

3.5.4 Beaver Creek Project

The Beaver Creek CO_2 Project area is in the Wind River/Bighorn River Drainage and the Sweetwater River/North Platte River Drainage. The watersheds are composed mainly of rangelands with relatively few perennial streams. The trunk pipeline would cross two perennial streams three times, including crossing the Sweetwater River at milepost 25 (see Table 3-13) and Crook's Creek at mileposts 40 and 42. Perennial streams in the BLM's Lander Resource Area are generally of good quality. Area streams do, however, have the potential to carry very large amounts of TDS. Concentrations of TSS resulting from soil erosion are considered the most serious surface water pollutant in the BLM Lander Resource Area. Table 3-14 summarizes available flow and quality data for the project area.

3.5.5 Little Buffalo Basin Project

The Little Buffalo Basin Project area is in the Bighorn River Drainage, which is a major tributary to the Yellowstone River. The spur pipeline would cross two perennial streams, Buffalo Creek and Gooseberry Creek, at three locations (Table 3-13). Human activities have accelerated natural erosion but sediment from natural erosion is considered the most serious water quality problem in the area (BLM, 1982b). Overall, water quality is poor (exceeding standards for Class II waters), due to bacterial contamination at lower elevations from livestock and wildlife grazing (BLM, 1982b).

3.5.6 Salt Creek Project

The Salt Creek Project area is drained by tributaries of the Missouri River System and is in the Powder River Sub-Basin. The project area includes the Salt Creek Area of Critical Environmental Concern. The spur pipeline would be constructed in the Castle Creek Sensitive Watershed and adjacent to the Teapot Creek Sensitive Watershed (BLM, 1984a).

The Salt Creek Pipeline would not cross any perennial streams. There are 18 crossings of intermittent and ephemeral streams. Salt Creek has the highest concentration of salts and TDS in the BLM's Platte River Resource Area. Oil field discharge of produced water contributes to this (BLM, 1984a). Total suspended solids are high due to the surface disturbance in the oil fields and sparse vegetative cover.

Associated Projects. Numerous ephemeral drainages and one perennial stream, Middle Fork Casper Creek, would be crossed by the Bairoil/Dakota Pipeline (see Table 3-13).

3.5.7 Beaver Creek Alternative

The Beaver Creek Alternative alignment section is in the Wind River/Bighorn River Drainage. The watershed is composed mainly of rangelands with few perennial streams. This alignment section would cross one perennial stream, Bridger Creek (see Table 3-13). In addition, the alternative would cross intermittent and ephemeral streams at 47 locations. The right-of-way would be diverted from the existing pipeline right-of-way in the vicinity of milepost 5 in order to avoid a pond. Perennial streams in the Lander Resource Area are generally of good quality. However, area streams have the potential to carry

very large amounts of TDS. Concentrations of TSS resulting from soil erosion are considered the most serious surface water pollutant in the Lander Resource Area.

The Beaver Creek Alternative alignment would affect the water resources environment described for the Beaver Creek Trunk Pipeline and the Elk Basin Trunk Pipeline. All perennial streams crossed by these two projects would be crossed by the Beaver Creek Alternative alignment.

3.5.8 Frontier/Casper Alternative

The Frontier Section of the Frontier/Casper Alternative is in the Green River Basin. The region is composed of tablelands dissected by gullies, canyons and broad stream valleys.

The pipeline would cross no perennial streams, but there would be 58 crossings of intermittent and ephemeral streams, including Shute Creek, South Fork of Shute Creek, Demming Draw and unnamed tributaries to the Green River.

The Casper Section of the Frontier/Casper Alternative is drained by tributaries of the Missouri River System and is in the Powder River and North Platte River sub-basins. The pipeline would be constructed in the Salt Creek Area of Critical Environmental Concern and the Teapot Creek and Castle Creek sensitive watersheds (BLM, 1984a).

The Casper Section would cross one perennial stream, Casper Creek, at milepost 39 (see Table 3-13). In addition, the pipeline would cross intermittent and ephemeral streams (including Castle Creek, Teapot Creek and East Teapot Creek) at 48 locations.

3.5.9 Exxon Alternative CO_2 Supply

The Phase II Shute Creek Plant site is in the Green River drainage area (Tables 3-13 and 3-14) in the Shute Creek drainage basin. Shute Creek is described for the Fontenelle Project. The Phase II construction site is south of the well defined 50-ft wide channel which forms the north drainage tributary to Shute Creek. The southern drainage consists of several poorly defined channels which traverse the southern third of the Phase II plant site. The 100-year peak flow in the south drainage is estimated at 300 cfs and the floodplain is conservatively estimated as 600 feet or less (Exxon, 1985). The Phase II plant would be constructed at least 500 feet from the 100-year floodplain. In addition, the flow from the poorly defined south drainage would be diverted around the plant site in perimeter drainage ditches.

The feed gas pipeline would be constructed in the Green River drainage Basin. The area is characterized by limited perennial waters but numerous intermittent streams. Weathered sedimentary rocks have produced highly erodible soils with high mineral content. Leaching of these soils has produced waters with relatively high total dissolved solids and high suspended solids when stream flows are high. The feed gas pipeline would cross four perennial, one intermittent and numerous ephemeral creeks.

The wellfield is drained by a system of intermittent streams which flow eastward to the Green River. The area is bounded on the north by North Piney Creek and on the south by LaBarge Creek. Major streams in the wellfield include Middle Piney, South Piney and Dry Piney creeks. Many of the lower reaches are dry because of both seasonal low flows and irrigation use. Numerous springs and seeps are evident in the wellfield. Water quality is generally good although TSS can be high during runoff events. Since

soils in the wellfield appear to be relatively erodible and slopes relatively steep, it is possible that natural sediment loads during high runoff approach the transport capacity of the streams (BLM, 1983c).

3.5.10 No Action Alternative

The affected environment for water resources for the No Action Alternative would be the same as previously described for Amoco's Proposed Actions in Sections 3.5.2 and 3.5.6.

3.6 WILDLIFE RESOURCES

3.6.1 Introduction

Information regarding the occurrence of important wildlife habitat in the vicinity of Amoco's Proposed Actions and project alternatives was taken from a variety of sources, including BLM resource management plans, BLM file data and information provided by the Wyoming Game and Fish Department. Wildlife data for the Exxon Alternative CO_2 Supply was extracted primarily from the Wyoming Industrial Siting Application (Exxon, 1985) and from the Riley Ridge Environmental Impact Statement (BLM, 1983c). No site specific surveys to verify existing wildlife data or to supplement known locations were conducted. Certain studies (particularly for *endangered species* and raptor nests) will be conducted prior to the start of construction.

Antelope and mule deer are the principal big game mammals found in the vicinity of Amoco's Proposed Actions and project alternatives. In addition, construction of Phase II of Exxon's LaBarge Project would occur in known crucial elk, moose and big horn sheep range. Some areas of crucial winter range would be crossed by the Proposed Action spur and trunk pipelines and alternative pipeline alignments.

Sage grouse, an upland game bird, occur throughout the Proposed Action project areas and in the vicinity of project alternatives. *Leks* and adjoining nesting habitat provide crucial seasonal habitat. Several raptorial bird species utilize the Proposed Actions and alternative project areas. Golden eagle, ferruginous hawk, Swainson's hawk, red-tailed hawk, goshawk, northern harrier, kestrel, burrowing owl, great horned owl and prairie falcon nesting has been noted in the vicinity of various project components, as well as in the vicinity of most alternatives.

Many small mammal species utilize the assorted habitats which would be affected by various project components, as do a limited number of species of amphibians and reptiles. Prairie dog concentrations are considered important because of the potential association of the endangered black-footed ferret.

Big game crucial ranges, sage grouse leks and associated nesting habitat, raptor nesting sites and prairie dog concentrations in the vicinity of the Proposed Actions and alternatives are described in Tables 3-15 through 3-18.

Aquatic species of concern in the project areas and in the vicinity of project alternatives are generally limited to salmonid fishes. Stream ratings, which provide an indication of the fishery potential of streams affected by the Proposed Actions and project alternatives, were listed in Table 3-13.

Four endangered animal species were noted by the U.S. Fish and Wildlife Service as possibly occurring in the vicinity of the Proposed Actions (Appendix 2): the bald eagle, peregrine falcon, whooping crane and black-footed ferret. The potential for occurrence of federally endangered or *threatened species* in the vicinity of project alternatives also includes these four species. No species pro-

Table 3-15. Crucial Big Game Winter Ranges in the Vicinity of the Proposed Actions and Alternatives. Seasonal Restrictions Apply From November 15 to April 30.

Project	Species	Milepost	Miles Crossed	Short-term Acres Affected (Long-term)	Distance from Right-of-Way (mi)	Acres of Crucial Winter Range in Wellfield (approximate)
FONTENELLE						
Pipeline	Deer & Antelope	2W-7.5W	5.5	49.9	0.0	
	Moose	7-13.5	6.5	59.2	0.0	
Plant Site	No ranges affected		--	--	--	
Wellfield	Moose	--	--	263(192) (c)	--	800
(20,000 acres) (a)	Deer & Antelope		--	263(192) (c)	--	1970
ELK BASIN						
Pipeline	Deer	54.0-55.2	--	--	1.1	
	Deer & Antelope	66.0-69.0	--	--	0.4	
	Deer & Antelope	69.0-73.1	4.1	37.3	0.0	
	Antelope	80.2-85.4	5.2	47.3	0.0	
	Deer	102.4-108.4	6.2	56.4	0.0	
	Antelope	108.4-117.4	9.0	81.8	0.0	
	Deer & Antelope	121.2-134.1	12.9	117.3	0.0	
	Antelope	134.2-143.1	8.9	80.9	0.0	
	Deer	135.0-136.0	1.0	9.1	0.0	
	Antelope	146.8-147.8	1.0	9.1	0.0	
	Antelope	155.1-155.9	0.8	7.3	0.0	
	Antelope	174.8-177.0	--	--	0.1-0.7	
Plant Site	No ranges affected		--	--	--	
Wellfield (8,500 acres) (a)	No ranges affected		--	--	--	
Associated Projects	Deer and Antelope	112.0-136.0	24.0	288.0	0.0	
(Bairoil/Dakota	Elk	180.0-185.0	5.0	60.0	0.0	
milepost 112-185)	Elk Calving Area (b)	114.5-115.5	1.0	12.0	0.0	
BEAVER CREEK						
Pipeline	Antelope	0-2.1	2.1	19.1	0.0	
	Antelope	21.5-38.6	17.1	155.0	0.0	
Plant Site	Antelope	--	--	(40)		
Wellfield	Antelope	--	--	228 (c)		11000
(17,000 acres) (a)						
LITTLE BUFFALO BASIN						
Pipeline	Deer & Antelope	0-2.0	--	--	0.7	
	Antelope	4.6-8.6	--	36.4	0.0	
	Deer	9.0-11.8	--	--	0.1-1.0	
	Antelope	8.0-13.0	--	--	0.2-1.2	
	Deer & Antelope	13.0-15.5	--	--	0.1-1.6	
	Deer & Antelope	20.3-28.4	--	--	0.4	
	Deer & Antelope	27.8-36.0	--	--	0.8	
Plant Site	No ranges affected					
Wellfield	Deer & Antelope			819 (c)		1600
(16,000 acres) (a)						

Table 3-15. Continued.

Project	Species	Milepost	Miles Crossed	Short-term Acres Affected (Long-term)	Distance from Right-of-Way (mi)	Acres of Crucial Winter Range in Wellfield (approximate)
SALT CREEK						
Pipeline	No ranges affected					
Plant Site	No ranges affected					
Wellfield (10,000 acres) (a)	No ranges affected					
Associated Project: (Bairoil/Dakota milepost 185-221)	Antelope	185.0-195.0	10.0	120.0	0.0	
BEAVER CREEK ALTERNATIVE						
Pipeline (d)	Antelope	0-1.0	1.0	9.1	0.0	
	Antelope	14.0-15.0	1.0	9.1	0.0	
	Antelope	33.0-34.0	1.0	9.1	0.0	
	Antelope	23.0-26.3	3.3	30.0	0.0	
	Deer & Antelope	47.0	--	--	0.5	
	Deer & Antelope	47.0-55.0	8.0	72.7	0.0	
FRONTIER/CASPER ALTERNATIVE						
Frontier Access	No ranges affected					
Casper	No ranges affected					
EXXON ALTERNATIVE CO2 SUPPLY						
Feed Gas Trunkline	Deer and	5.5-23.0	17.5	159.3	0.0	
	Antelope	24.0-31.5	7.5	88.3	0.0	
	Moose	15.0-16.0	1.0	9.1	0.0	
	Moose	23.0-24.0	1.0	9.1	0.0	
	Moose	32.0-33.0	1.0	9.1	0.0	
	Elk	5.5-8.5	3.0	27.3	0.0	
	Elk	14.5-17.0	2.5	22.7	0.0	
Plant Site	No ranges affected					
Wellfield	Deer			736(376)		7300
	Big Horn Sheep			736(376)		5300
	Moose			736(376)		13000
	Elk			736(376)		30700

a = Approximate acres in wellfield.
b = Elk calving area restrictions apply from May 1 to June 30.
c = Total worst-case affected acres in wellfield.
d = From preliminary baseline maps.

Table 3-16. Known Prairie Dog Concentrations in the Vicinity of the Proposed Actions and Alternatives. Restriction on Construction Applies Until Cleared for Black-footed Ferrets.

Project	Milepost	Miles Crossed	Acres Affected	Distance from Right-of-Way (mi)
FONTENELLE				
Pipeline	3.0	--	--	0.7
Plant Site	No concentration areas known			
Wellfield	Confirmed Sighting of Black-footed Ferret			2.0 (a)
ELK BASIN				
Pipeline	1.7-1.8	--	--	1.8
	2.2-3.8	--	--	0.3
	26.5-28.0	--	--	0.1
	39.5-40.2	--	--	0.5
	39.6-40.1	0.5	4.5	0.0
	66.1-66.6	0.5	4.5	0.0
	67.6-68.6	1.0	9.1	0.0
	73.0-73.4	--	--	0.4
	73.5-75.0	--	--	0.6-1.0
	75.7-76.2	--	--	0.3-0.5
	76.5-77.0	--	--	1.6
	77.0-78.0	--	--	1.0
	124.1-124.2	--	--	0.5
	131.4-132.1	0.7	6.4	0.0
	136.2	--	--	1.8
	137.6	--	--	1.7
	137.5-139.0	--	--	0.1-0.5
Plant Site	No concentration areas known			
Wellfield	2 concentration areas known approximately 40 acres in wellfield			
Associated Project: (Bairoil/Dakota milepost 112-185)	119.0-120.5	1.5	18.0	0.0
	121.0-121.5	0.5	6.0	0.0
	128.0-129.5	1.5	18.0	0.0
	146.5-147.0	0.5	6.0	0.0
	152.5-153.0	0.5	6.0	0.0
BEAVER CREEK				
Pipeline	3.0	--	--	1.1
	29.0	--	--	0.3
	30.2	--	--	0.4
	43.8-44.4	--	--	0.2
Plant Site	No concentration areas known			
Wellfield	No concentration areas known			
LITTLE BUFFALO BASIN				
Pipeline	0-1.4	1.4	12.7	0.0
	1.8-2.4	0.6	5.5	0.0
	3.0-3.2	--	--	0.1
	3.4-3.6	--	--	0.3
	13.8-15.0	--	--	1.8-2.1
	15.2-19.0	--	--	0.2-1.4
	20.1-20.6	--	--	0.7
Plant Site	1 concentration area			
Wellfield	4 concentration areas approximately 2,240 acres (b)			

Table 3-16. Continued.

Project	Milepost	Miles Crossed	Acres Affected	Distance from Right-of-Way (mi)
SALT CREEK				
Pipeline	7.0-7.8	0.8	7.3	0.0
Plant Site	No concentration areas known			
Wellfield	No concentration areas known			
Associated Project: (Bairoil/Dakota milepost 185-221)	No concentration areas known			
BEAVER CREEK ALTERNATIVE	52.5	--	--	0.6
	52.5	--	--	1.3
	53.7	--	--	0.3
FRONTIER CASPER/ALTERNATIVE	0-0.6	0.6	5.5	0.0
	1.8-2.7	0.9	8.2	0.0
Frontier Access Section	2.0-3.3	--	--	0.2
	3.6-3.8	0.2	1.8	0.0
	12.0-13.0	--	--	0.4
	19.5-22.0	1.5	13.6	0.0
	21.5-21.8	--	--	0.1
	22.2-23.0	0.8	7.3	0.0
Casper Section	unknown			
EXXON ALTERNATIVE CO2 SUPPLY				
Feed Gas Trunkline	1.0	0.25		
	14.25 (a)	--	--	
	16.5	--	--	0-0.5
	17.0	--	--	1.0
	18.0	--	--	1.0
	14.0	--	--	0.5
	19.5	--	--	0-0.25
	20.0	1.0	9.1	0
	21.0	0.25	2.3	0
	24.0	--	--	0.5
	25.5	0.25	2.3	0
	26.0	1.0	9.1	0
	25.0	--	--	0.5
	27.0	--	--	0-0.25
	27.0	--	--	0.5
	28.0	--	--	0-0.25
	28.0	--	--	0.5
	28.0	--	--	0-0.25
Plant Site	No concentration areas known		--	--
Wellfield	1 concentration area			

a = Confirmed sighting of Black-footed ferret (BLM, 1983c).
b = Includes one concentration area at the plant site.

Table 3-17. Sage Grouse Nesting/Rearing Habitat in the Vicinity of the Proposed Actions and Alternatives. Seasonal Restrictions Apply From February 1 to July 31.

Project	Milepost	Miles Crossed	Acres Affected	Distance from Right-of-Way (mi)
FONTENELLE				
Pipeline	0-2.2	2.2	20.0	0.0
Plant Site			40	1.5(b)
Wellfield	No nesting/rearing habitat known		--	--
ELK BASIN				
Pipeline	0-9.4	9.4	85.4	0.0
	29.8-34.2	4.4	40.0	0.0
	35.6-41.4	5.8	52.7	0.0
	121.0-127.0	6.0	54.6	0.0
	139.7-143.2	3.5	31.8	0.0
Plant Site	2 nesting/rearing habitat known			1.5, 1.0 (b)
Wellfield	3 nesting/rearing habitat known (c)			
Associated Project (Bairoil/Dakota milepost 112-185)	160-164	4	48	0.0
	168-173	5	60	0.0
	181-182	1	12	0.0
BEAVER CREEK				
Pipeline	17.0-21.0	--	--	0.6
	30.8-34.3	3.5	31.8	0.0
Plant Site	No nesting/rearing habitat known		--	--
Wellfield	No nesting/rearing habitat known		--	--
LITTLE BUFFALO BASIN				
Pipeline	0.2-2.4	2.4	21.8	0.0
	3.2-7.4	4.2	38.2	0.0
	8.9-15.3	6.4	58.2	0.0
	20.2-24.1	3.9	35.4	0.0
	27.7-30.0	2.3	20.9	0.0
Plant Site	6 nesting/rearing areas		40	1@.75 (b) 1@1.0 (b) 4@1.5 (b)
Wellfield	6 nesting/rearing areas (c)			
SALT CREEK				
Pipeline	No nesting/rearing habitats known		--	--
Plant Site	No nesting/rearing habitats known		--	--
Wellfield	No nesting/rearing habitats known		--	--
Associated Project: (Bairoil/Dakota milepost 185-221)	197-199	2	24	0.0
BEAVER CREEK ALTERNATIVE	No nesting/rearing habitats known			
FRONTIER/CASPER ALTERNATIVE				
Frontier Access Section	5.9-9.6	3.7	33.7	0
	15.9-19.5	3.6	32.8	0
	22.8-24.0	1.2	10.9	0
Casper Section	10.8-14.2	--	--	1.2
EXXON ALTERNATIVE CO2 SUPPLY				
Feed Gas Trunkline	25.0-28.5	3.5	31.5	0.0
Plant Site	No nesting/rearing habitat		--	--
Wellfield	9 nesting/rearing habitats		--	--

a = Leks affected; one 0.8 and 1.5 miles from right-of-way.
b = Distance of lek from plant site.
c = Number of nesting/rearing habitats in the wellfield includes those indicated for the plant site.

Table 3-18. Known Raptor Nest Sites in the Vicinity of the Proposed Actions and Alternatives. Seasonal Restrictions Apply From February 1 to July 31.

Project	Species	Approximate Milepost	Radius of Area (mi) (a)	On Right-of-Way
FONTENELLE				
	Golden Eagle	9	0.6	No
	Kestral	9	0.3	No
	Red-Tail Hawk	12	0.3	No
	Golden Eagle	12	0.6	No
	Bald Eagle Winter area	9.6-9.8		Yes
Plant Site	No nests			
Wellfield	Golden Eagle (2)		0.6	
	Red-Tail Hawk		0.3	
	Ferruginous Hawk (2)		1.2	
	Bald Eagle Winter area		0.8	
	Prairie Falcon		0.6	
ELK BASIN				
Pipeline	Great Horned Owl	27.5-28.5	0.6	Yes
	Swainsons Hawk	29	0.6	No
	Northern Harrier	30	0.6	No
	Kestrel	32-33	0.3	Yes
	Golden Eagle	32.5-33.5	0.6	Yes
	Burrowing Owl	39.5-40.5	0.6	Yes
	Golden Eagle	39.5-40.5	0.6	Yes
	Ferruginous Hawk (2)	61-64	1.2	Yes
	Golden Eagle (3)	89,98,99	0.6	No
	Red-Tail Hawk (7)	103,104,106 107,109 115,118	0.3	No
	Red-Tail Hawk	113-114	0.3	Yes
	Ferruginous Hawk	117-119	1.2	Yes
	Ferruginous Hawk (2)	120-124	1.2	Yes
	Golden Eagle	135	0.6	No
	Northern Harrier	145	0.5	No
	Red-Tail Hawk	145	0.3	No
	Golden Eagle	147	0.6	No
	Red-Tail Hawk	157	0.3	No
	Ferruginous Hawk (3)	158-161	1.2	Yes
	Golden Eagle	160	0.6	No
	Ferruginous Hawk (2)	160.5-162.5	1.2	Yes
	Golden Eagle	163	0.6	No
	Ferruginous Hawk (3)	164	1.2	No
	Golden Eagle	168	0.6	No
	Ferruginous Hawk (2)	169-172	1.2	Yes
Plant Site	No nests			
Wellfield	No nests			
Associated Project: (Bairoil/Dakota milepost 112-185)	Unknown Raptor Nest	165	.3	Yes
		171	.3	Yes
		174.5	.3	Yes
	Bald Eagle winter area	180-185		Yes
BEAVER CREEK				
Pipeline	Burrowing Owl	3	0.6	No
	Golden Eagle	6	0.6	No
	Prairie Falcon	39	0.6	No

Table 3-18. Continued.

Project	Species	Approximate Milepost	Radius of Area (mi)	On Right-of-Way
Plant Site	No nests			
Wellfield	Burrowing Owl			
LITTLE BUFFALO BASIN				
Pipeline	Red-Tail Hawk	6	0.3	No
	Golden Eagle	9	0.6	No
	Ferruginous Hawk	15	1.2	Yes
Plant Site	No nests			
Wellfield	No nests			
SALT CREEK				
Pipeline	Unidentified Buteo	5	0.5	Yes
Plant Site	No nests			
Wellfield	No nests			
Associated Project: (Bairoil/Dakota milepost 185-221)	Raptor Nests	187.5		Yes
Beaver Creek Alternative	Golden Eagle	38	.6	Yes
	Burrowing Owl			
	Red-Tail Hawk	41	0.3	No
	Prairie Falcon	55	0.6	No
FRONTIER/CASPER ALTERNATIVE				
Frontier Access Section	None			
Casper Section	Golden Eagle	8	0.6	No
	Golden Eagle	9	0.6	No
	Golden Eagle	11	0.6	No
	Golden Eagle	15	0.6	No
	Golden Eagle	25	0.6	No
	Ferruginous Hawk	26	1.2	No
	Swainsons Hawk	38	0.6	No
EXXON ALTERNATIVE CO2 SUPPLY				
Pipeline	Golden Eagle	29	0.6	No
Plant Site	Whooping Crane	10-13		Yes
Wellfield Activities	No known nests			
	Golden Eagle		0.6	
	Golden Eagle		0.6	
	Praire Falcon		0.6	
	Golden Eagle		0.6	
	Goshawk		0.6	
	Praire Falcon		0.6	

a = Radii listed are used only as a guideline for estimating potential impact. Specific locations for enforcement of seasonal restrictions would be determined through site surveys during the year of constuction.

posed for listing were indicated in the Section 7 consultation list for Amoco's Proposed Actions. Candidate species noted by the U.S. Fish and Wildlife Service included white-faced ibis, Swainson's hawk, ferruginous hawk, mountain plover, long-billed curlew, Allen's 13-lined ground squirrel, narrow-footed hygrotus diving beetle and the Wyoming Cave Snail. Known habitat for the Wyoming Cave Snail is limited to one cave which would not be affected by the proposed projects or their alternatives.

3.6.2 Fontenelle Project

The area generally following the Green River in the vicinity of the Fontenelle Gas Gathering System and Raptor Field contains important wildlife habitats. Crucial winter ranges for deer, antelope and moose would be crossed by the gas gathering pipeline (Table 3-15). The pipeline would cross nesting habitat associated with one sage grouse lek. Seven nest locations for raptors also have been mapped, four are within the wellfield and three along the pipeline. Specific locations for raptor nests in the project areas have not been identified in this DEIS to protect the nests. The entire area along the Green River in the vicinity of the proposed gas gathering system pipeline crossing has been designated as crucial nesting habitat for the merlin, but no specific nests have been mapped by wildlife agencies. Bald eagles also concentrate along the Green River and its tributaries during October through May. When most rivers and lakes are frozen the eagles concentrate on larger bodies of water, mainly the Green River, Fontenelle Reservoir, and Seedskadee National Wildlife Refuge, near open water where fish may be caught (BLM, 1983c).

The Green River below Fontenelle Dam is designated a Class 1 Trout Fishery-fishery of national importance. Repair work to Fontenelle Dam has required draining of Fontenelle Reservoir, diminishing the fishery and habitat in the reservoir. Kokanee salmon run from Flaming Gorge Reservoir to the area below Fontenelle Dam to spawn. Resident brown trout also spawn in the area. Spawning for both species begins in October.

One prairie dog concentration has been mapped in the area (see Table 3-16). Sightings of black-footed ferrets have been reported in the past from the Seedskadee Wildlife Refuge south of the project area. An area along Fontenelle Creek has been designated of importance to the whooping crane.

In the area of the proposed Fontenelle Plant site there are no crucial big game habitat range, known prairie dog concentration areas or raptor nests. The plant site is on the fringe of a sage grouse nesting and rearing area The Raptor Field is within designated crucial winter range of moose, deer and antelope.

3.6.3 Elk Basin Project

Nine areas of big game crucial winter range would be crossed by the 177-mile trunk pipeline. Two of the areas are designated for mule deer, five for antelope and two areas are used jointly by both species. Three other areas of crucial winter range are noted within the two-mile corridor containing the proposed pipeline, but would not be crossed by the pipeline itself (Table 3-15). Eight mule deer herd units and seven antelope herd units utilize parts of the proposed route.

Seventeen sage grouse leks were mapped within the two-mile corridor of the centerline of the Elk Basin Trunk Pipeline. Five areas of sage grouse nesting/rearing habitat would be crossed by the pipeline (see Table 3-17). Two sage grouse leks have been mapped on or near the right-of-way (Table 3-17). Field checks with Cody BLM Wildlife Biologists found that the

actual strutting area on one lek was east of the right-of-way. The second lek was in the map base from a 1972 report with an imprecise location, with no newer information on location or use available. These two leks may have occupied an area cleared during construction of the existing Colorado Interstate Gas Pipeline right-of-way. The Elk Basin Trunk Pipeline would be routed adjacent to the existing pipeline. Forty-one raptor nest sites, representing eight species (see Table 3-18), have been identified within the two-mile corridor of the Elk Basin Pipeline centerline.

Twelve perennial streams would be crossed by the proposed pipeline, most containing some fishery capability. All are rated Class 3 or 4 by the Wyoming Game and Fish Department (1987e). Bitter Creek contains brown trout and some rainbow trout. The Shoshone River has brown trout, whitefish and rainbow trout. The McConaughy strain of rainbow trout has been stocked over the last 15 years. The Greybull River contains whitefish and brown trout. Data are not available on Willow Creek (Class 5). The Bighorn River has brown and rainbow trout, with smallmouth bass planted in the general proposed pipeline crossing area. Kirby and West Bridger creeks have brook trout, and have spawning habitat in the vicinity of the proposed trunk pipeline crossings. West Kirby and Bridger creeks do not have apparent spawning habitat at the proposed crossings.

Four areas of prairie dog concentrations would be crossed by the proposed pipeline. An additional 13 areas occur within the mapped two-mile corridor around the proposed pipeline, but would not be crossed by the pipeline (Table 3-16).

The 13-lined ground squirrel occurs throughout the central United States. One of the Wyoming subspecies, *Spermophilus tridecemlineatus alleni*, is a federal candidate species and listed as a species of concern by the Wyoming Heritage Program. This subspecies has been reported from the Bighorn Basin.

The recycle plant site within the Elk Basin Field would not disturb any crucial big game ranges or prairie dog concentration areas. The plant would be in nesting and rearing habitats of two sage grouse leks.

In the Elk Basin Field there are no crucial big game ranges that will be affected by the Proposed Action. There are three sage grouse nesting and rearing areas and two prairie dog concentration areas within the field.

Associated Projects. The Bairoil/Dakota Pipeline will cross crucial winter range for deer, antelope and elk. The pipeline will also cross approximately one mile of an elk calving area. Five prairie dog concentration areas and three sage grouse nesting and rearing areas will be bisected by this segment of pipeline. Three raptor nest and a bald eagle wintering area are also in the vicinity of this project.

3.6.4 Beaver Creek Project

Two areas of crucial antelope winter range would be crossed by the proposed trunk pipeline (Table 3-15). An area of antelope crucial winter range is within the two-mile corridor containing the proposed pipeline, but is not intersected by it. Mule deer belong to the Green Mountain and Beaver Rim Herd units; antelope are included in the Split Rock, Long Creek and Sand Draw hunt areas.

One area of sage grouse nesting/rearing habitat would be crossed by the trunk pipeline, and a second area is mapped within the two-mile corridor around the pipeline (Table 3-17). Three raptor nest sites were identified within the two-mile corridor, associated with a burrowing owl, golden eagle and prairie falcon.

Two perennial streams would be crossed several times by the trunk pipeline. The Sweetwater River has some brown trout in this vicinity and Crooks Creek contains brook trout. Both streams have a trout stream classification of 3.

No prairie dog concentrations are known on the proposed pipeline right-of-way. Four areas have been noted along the two-mile corridor containing the pipeline (see Table 3-16).

The only crucial big game winter range in the area of the proposed Beaver Creek Recycle Plant site is antelope range. There are also no raptor nests, sage grouse nesting or rearing areas or prairie dog concentration areas in the vicinity of the plant site.

Within the Beaver Creek Field, only crucial antelope winter range and one burrowing owl nest are known to exist. No sage grouse nesting or rearing areas or prairie dog concentration areas occur within the wellfield.

3.6.5 Little Buffalo Basin Project

One area of antelope crucial winter range would be crossed by the proposed pipeline. A second area used by antelope, one by mule deer and four areas used by both species as crucial winter range occur within the two-mile corridor containing the spur pipeline (Table 3-15). Mule deer belong to the Basin Herd Unit; antelope are included in the Fifteen-Mile Hunt Area.

Eleven sage grouse leks have been mapped within the two-mile corridor. None are known to occur on the pipeline right-of-way. Five areas of nesting habitat would be crossed by the pipeline right-of-way (Table 3-17). Three raptor nesting sites are known to occur within two miles of the proposed spur alignment: one red-tailed hawk, one golden eagle and one ferruginous hawk.

Two perennial streams would be crossed by the spur pipeline. Both Gooseberry and Buffalo creeks have a designated trout fishery classification of 4; neither supports a fishery of concern.

Two areas of prairie dog concentrations would be crossed by the proposed pipeline, and an additional five areas are known to occur within the two-mile corridor containing the pipeline right-of-way. Habitat for the mountain plover, long-billed curlew and Swainson's hawk would be affected by the spur line. The Bighorn Basin is also the reported range for Allen's 13-lined ground squirrel.

At the proposed recycle plant site there are no crucial big game ranges or raptor nest that will be affected. One prairie dog concentration area and six sage grouse nesting and rearing areas exists in the vicinity of the plant site.

Within the Little Buffalo Basin Field there is one area designated as deer and antelope crucial winter range, six sage grouse nesting and rearing areas and four prairie dog concentration areas. No raptor nests are known to exist.

3.6.6 Salt Creek Project

No big game *crucial habitats* occur in the general area of the Salt Creek Pipeline. No sage grouse nesting/rearing habitat is present. Two raptor nest sites, both unidentified *Buteo* species, have been mapped within the two-mile corridor containing the proposed pipeline. One prairie dog concentration has been mapped on the proposed pipeline right-of-way. No perennial streams would be crossed.

The narrow-footed diving beetle, a Category 2 candidate species, has been found in drainages in the area (BLM, 1985a). The proposed pipeline would cross intermittent drainages in the area.

No big game crucial habitats, raptor nests, sage grouse nesting and rearing areas or prairie dog concentration areas are known to exist in the vicinity of the plant site or in the wellfield.

Associated projects. The Bairoil/ Dakota Pipeline will cross one area designated as crucial winter range for antelope and one sage grouse nesting and rearing area. One raptor nest is also known to exist within the vicinity of this segment of pipeline. No prairie dog concentration areas are known to be crossed by this segment of pipeline.

3.6.7 Beaver Creek Alternative

One area of crucial winter range used by antelope and one area used by both mule deer and antelope would be crossed by the alternative pipeline alignment. A second area, utilized by both species as crucial winter range, is within the two-mile corridor of the alternative right-of-way (see Table 3-15). Mule deer belong to the Beaver Rim and Badwater herd units. Antelope are included in the Fremont and Badwater hunt areas.

Three raptor nest sites associated with a burrowing owl, red-tailed hawk and a prairie falcon are known to occur within the two-mile corridor (see Table 3-18). Bridger Creek contains brook trout, but does not have spawning habitat in the vicinity of the alternative pipeline crossing. Three areas of prairie dog concentrations have been mapped within the two-mile corridor (see Table 3-16), but none are known on the alternative right-of-way.

3.6.8 Frontier/Casper Alternative

The Frontier Access Section of this alternative would be aligned in the same corridor as the existing Rangely CO_2 Pipeline. Wildlife information for this portion of the Frontier/ Casper Alternative has been taken from the Rangely EIS (BLM, 1984b) and the Riley Ridge EIS (BLM, 1983c).

Three areas of sage grouse nesting/ rearing habitat would be crossed by the Frontier Access Section. Raptor nest sites are concentrated along the Green River. Between mileposts 13 and 24, the proposed pipeline right-of-way roughly parallels the Green River, lying one to two miles west of the river. Approximately 20 nest sites have been mapped along this stretch of the Green River. No perennial streams would be crossed by the proposed pipeline. Five areas of prairie dog concentrations would be crossed by the proposed pipeline, with an additional three areas within the two-mile corridor.

The Casper Section of this alternative would deviate from the existing Frontier Pipeline northwest of Casper running north to the Salt Creek Field. No areas of designated big game crucial winter range occur along the right-of-way. One area of sage grouse nesting/rearing habitat is known to occur within the two-mile corridor (Table 3-17). Eight raptor nest sites have been mapped, associated with golden eagle (6), ferruginous hawk (1) and Swainson's hawk (1), within the two-mile corridor (Table 3-18).

One perennial stream, Casper Creek, would be crossed. Casper Creek is rated as a Class 4 trout fishery and contains rainbow trout. The narrow-footed hygrotus diving beetle has been reported in drainages to be crossed by the Frontier/Casper Alternative (BLM, 1985a). No prairie dog concentrations have been mapped within the two-mile corridor along the Casper Section.

3.6.9 Exxon Alternative CO_2 Supply

The feed gas trunkline for this alternative would cross designated areas

of crucial winter ranges for deer, antelope, moose and elk. One sage grouse nesting and rearing area, and 17 prairie dog concentration areas would be crossed with this alternative. Sightings of black-footed ferrets have been confirmed on the pipeline route (BLM, 1983c). However, none have been confirmed since 1978. Near the pipeline one golden eagle nest also exists. An area designated as important to whooping cranes will also be crossed with this alternative.

Streams which would be crossed by the feed gas trunkline include Shute Creek, Slate Creek, Fontenelle Creek, Muddy Creek, LaBarge Creek and Dry Piney Creek. Fontenelle Creek and LaBarge Creek are important tributaries to the Green River. Both streams are Class II cold water streams. Fontenelle Creek is used by spawning rainbow trout from Fontenelle Reservoir, other fish include cutthroat trout, brown trout and mountain whitefish. Populations are low. LaBarge Creek game fish include rainbow, brown, brook, cutthroat trout and mountain whitefish. Populations are low to moderate. Dry Piney Creek supports a limited trout population, and Slate Creek and Muddy Creek contain primarily nongame species (Exxon, 1985).

The Shute Creek Plant site is not within any known crucial big game ranges, raptor nests, or prairie dog concentration areas. One sage grouse nesting or rearing area is on the fringe of the plant site. The plant site is drained by Shute Creek which is an intermittent stream. It does not contain any habitat capable of sustaining aquatic life and is designated as a Class IV stream (Exxon, 1985).

However, within the Riley Ridge Field, crucial big game winter range exists for deer, moose, elk and bighorn sheep. Raptor nests known in the wellfield include: three golden eagle, two prairie falcon and one goshawk. Eight sage grouse leks and associated nesting and rearing areas are also within the wellfield and one lek is on the boundary of the field. Only one prairie dog concentration area has been mapped in the wellfield.

Aquatic resources for the Exxon Alternative CO_2 Supply has been described in detail in the Riley Ridge Environmental Impact Statement (BLM, 1983c). Streams that may be affected within the wellfield include Middle Piney Creek, South Piney Creek, Dry Piney Creek and their tributaries. Game fish in the streams include rainbow, brown, brook trout and mountain whitefish. Upper reaches of some streams contain populations of Colorado River cutthroat trout. This species is considered as a sensitive species (BLM, 1983c).

3.6.10 No Action Alternative

The No Action Alternative affected environment for wildlife resources is the same as previously described for the Proposed Actions in Sections 3.6.2 through 3.6.6.

3.7 AIR QUALITY

3.7.1 Introduction

The climate of the proposed project areas and in the vicinity of project alternatives is semi-arid with precipitation ranging from 5.5 to 12 inches per year. Greatest precipitation is received between April and June with the least received in winter months (National Oceanic and Atmospheric Administration, 1985). The climate is mid-continental which is marked by large annual, daily and day-to-day temperature ranges, with low relative humidity and generally moderate or small and irregular rainfall. Winds are generally from the west or southwest, persistent and strong. The winds contribute to good air quality by dispersing pollutants but can also degrade visibility and increase air

borne suspended *particulates*. Atmospheric dispersion is also enhanced during the day by strong surface heating providing for surface-based instability. This instability is limited at night, reducing dispersive capacity (BLM, 1983d).

The condition of the air resource in the areas is generally good, with ambient concentrations of regulated pollutants well below both *Wyoming (WAAQS)* and *National Ambient Air Quality (NAAQS)* standards (see Table 3-19) (BLM, 1983d; Exxon, 1985). Ambient concentrations of particulates are generally not as low as gaseous air pollutants, and may in some cases be attributable to natural sources of wind-blown or *fugitive dust*. All the proposed project and alternative project areas are considered Class II under Wyoming *Prevention of Significant Deterioration (PSD)* regulations. Under these regulations new pollutant sources must demonstrate that their incremental impacts will be below designated significance levels. Significance levels are considered baseline emission levels at a given location plus an incremental increase in emissions from the new source.

The potential for acid deposition from oil and gas development has been of special interest in the Jim Bridger and Fitzpatrick wilderness areas. These areas are designated as Class I areas under the PSD regulations and therefore have much lower allowable PSD *increments* (see Table 3-19). These wilderness areas are located approximately 65 miles northeast of the proposed Fontenelle Plant. Table 3-20 lists background acid rain monitoring data for Pinedale, Wyoming, which is part of the National Atmospheric Deposition Program (BLM, 1985b).

3.7.2 Fontenelle Project

The Fontenelle Project would be constructed and operated within National Oceanographic and Atmospheric Administration (*NOAA*'s) Green and Bear Drainage Climatological Division and the southern part of the Sublette Air Basin. Precipitation averages less than 9 inches per year (NOAA, 1985). The mean visual range is from about 70 miles north of the proposed plant site to about 110 miles south of the proposed plant site (BLM, 1983d; Latimer and Ireson, 1980). Visibility monitoring by Northwest Pipeline Company at the Craven Creek Plant Site (June 1982 - March 1983) indicates a slightly lower annual 50 percentile background visual range of about 60 to 75 miles and 65 to about 90 miles at the Shute Creek Plant site (Exxon, 1985).

Dispersion potentials were developed by the BLM (1985b) for the Fontenelle Project area, in the event that H_2S or other pollutants were released to the atmosphere. These potentials help determine the extent to which pollutants would be dispersed. These potentials were produced using stable atmospheric conditions and low wind speeds to depict realistic but worst case conditions. The Fontenelle Gas Processing Plant and the Raptor Field would be within an area designated as having low to medium pollution potential.

The most significant source of emissions in the Fontenelle Project area is the existing Exxon Shute Creek Plant. Other nearby sources of sulfur dioxide and nitrous oxides include Naughton Power Plant (near Kemmerer), Opal Gasoline Plant (near Opal), Whitney Canyon Gas Plant (near Evanston), Texas Gulf Trona Plant (near Green River) and Chevron's Phosphate Plant (near Rock Springs).

Emissions for Phase I and Phase II of Exxon's Shute Creek Plant have been reviewed and approved by the Wyoming Division of Environmental Quality (WDEQ)--Air Quality Division. Dispersion modeling of the air pollutants from the Shute Creek Plant was performed as part of the analysis required for the PSD permit application for the plant. A PSD permit was

Table 3-19. Wyoming and National Ambient Air Quality Standards and Prevention of Significant Deterioration Increments. (a)

Contaminants	Wyoming Standards (ug/m3)	National Standards (ug/m3) Primary	Secondary	PSD Increments Class I	Class II	Class III
TSP						
24-Hour (b)	150	260	150	10	37	75
Annual (c)	60	75	60	5	19	37
PM-10 (d) Inhalable Particulates						
24-Hour (b)	150	--	--	--	--	
Annual	50	--	--	--	--	
SO2						
3-Hour (b)	1,300	--	1,300	25	512	20
24-Hour (b)	260	365	--	5	91	182
Annual (e)	60	80	--	2	20	40
NO2						
Annual (e)	100	100	100	--	--	--
CO						
1-Hour (b)	40,000	40,000	40,000	--	--	--
8-Hour (b)	10,000	10,000	10,000	--	--	--
H2S (f)						
0.5-Hour (g)	70	--	--	--	--	--
0.5-Hour (h)	40	--	--	--	--	--
VOC	40 tons/year					

a = Temporary construction-related emissions as well as the more permanent operations-related impacts are subject to NAAQS and WAAQS. However, emissions resulting from emergency upsets and start-up and shut-down activities are exempted from NAAQS and WAAQS compliance.
b = Not to be exceeded more than once per year.
c = Annual geometric mean, never to be exceeded.
d = Proposed standard.
e = Annual arithmetic mean, never to be exceeded.
f = Wyoming ambient standard only.
g = Not to be exceeded more than twice per year.
h = Not to be exceeded more than twice in any five consecutive days.

Table 3-20. Rainfall pH Data from the Pinedale, Wyoming National Atmospheric Deposition Program Site. (a)

Year/ Month	Number of Observations	Mean pH
1982		
August	5	5.28
September	3	5.53
October	3	5.99
November	4	5.51
December	4	5.79
1983		
January	1	6.08
February	4	5.99
March	5	5.72
April	4	6.09
May	5	5.45
June	4	4.64
July	3	5.01
August	4	5.24
	49	5.56

a = Source: BLM, 1985b.

Table 3-21. Background Air Quality in BLM's Platte River Resource Area: Annual Arithmetic Means and Maximum Values.

Monitoring Location	Pollutants (Concentration in Micrograms Per Cubic Meter) TSP		NOX		SO2	
	Mean	Maximum	Mean	Maximum	Mean	Maximum
Casper	73	179	26	62	6	28
Irene Ranch	25	118	4	10	0	2

a = Source: BLM, 1984a.

required for the Exxon Plant because projected emissions of sulfur dioxide, nitrogen dioxide, hydrogen sulfide and reduced sulfur compounds were expected to exceed the 100 ton/year level. The dispersion modeling included Phase I and II of Shute Creek and all other existing sources in the project area. Amoco's Fontenelle Project would not likely require a PSD permit since no pollutant emissions are expected to exceed 100 tons per year.

Predicted emission rates from Phase II of the Shute Creek Plant (not yet constructed) were reported by Exxon (1985) at the following levels:

- Carbon monoxide--33.6 tons per year (tpy);
- Nitrogen oxides--317.2 tpy;
- Particulate matter--14.3 tpy;
- Sulfur dioxide--2677.8 tpy;
- Ozone (VOC emissions)--6.4 tpy;
- Hydrogen sulfide--193.6 tpy;
- Total reduced sulfur--4153.2 tpy.

Phase I and Phase II of the Shute Creek Plant do not violate WAAQS/NAAQS. The PSD increments are not exceeded by all PSD sources in the area combined. However, the combination of Phase I and Phase II with other sources in the area was modeled to consume 96 percent of the available 24-hour sulfur dioxide increment (Exxon, 1985). The highest concentrations typically occur in the high terrain areas of the Opal Bench, which is located two to three miles south of Exxon's Plant site, and on Dodge Rim approximately four miles north of the plant.

One of the major emissions for Exxon's Plant is carbonyl sulfide. No ambient air standards have been established for this compound because of a lack of data on health effects and environmental impacts of the pollutant.

The issue of potential acidic deposition has been addressed in various permit proceedings for Exxon's Shute Creek Plant. Exxon (1985) evaluated the potential for dry and wet acid deposition from sulfur dioxide and nitrogen dioxide emissions from Phase II in the PSD permit and Industrial Siting applications. The PSD permit application concluded that the deposition rates in the Bridger Wilderness Area would be insignificant. The resulting pH change in Bridger Wilderness Area lakes was estimated to be less than 0.01 pH units.

3.7.3 Elk Basin Project

The proposed Elk Basin Plant would be constructed and operated within NOAA's Big Horn Climatological Division. Annual precipitation averages about 5.5 inches at Deaver. Overall, the area averages about 7 to 8 inches. Hydrogen sulfide and SO_2 are present in the Elk Basin Field, but estimates of quantities from Amoco's existing operations are not available. Total suspended particulates (TSP) is the only contaminant for which long-term monitoring data are available in the project area. Monitoring stations at Lovell, Cody and Meeteetse had mean values for TSP of 32, 8 and 18 micrograms per cubic meter, respectively. There have not been any violations of the WAAQS standard for either the 24-hour or the annual standard at any of these stations. These values are well below Wyoming and National standards (see Table 3-19).

3.7.4 Beaver Creek Project

The Beaver Creek Project would be constructed and operated within NOAA's Wind River and Upper Platte Climatological Division and has annual precipitation of about 8 inches. Background visibility in the area is approximately 105 miles (BLM, 1986b).

Hydrogen sulfide-contaminated natural gas and oil is produced in the Beaver Creek Field. The Beaver Creek Field is considered to have a high potential for pollution based on general airflow patterns as influenced by local topography and meteorological conditions (BLM, 1986b).

3.7.5 Little Buffalo Basin Project

The Little Buffalo Basin Project Area is within NOAA's Big Horn Climatological Division. Average annual precipitation averages from about 8 to 10 inches (Soil Conservation Service, 1983b). Total suspended particulates is the only contaminant that has been monitored at the Meeteetse monitoring station. The long-term mean is 18 ug/m^3, which is well below WAAQS and NAAQS. Existing operations in the field emit unknown quantities of H_2S and SO_2.

3.7.6 Salt Creek Project

The Salt Creek Project would be constructed and operated within NOAA's Powder, Missouri and Tongue Drainage Climatological Division. Average annual precipitation is about 12 inches. The Salt Creek Field currently produces H_2S as a by-product of oil production and emits unknown quantities of H_2S and SO_2. The background rural annual geometric mean concentration of TSP for the region is about 15 ug/m^3 (BLM, 1984a). Air quality degradation is localized in and near populated areas and mining activities where particulate levels are significantly higher than background levels. Table 3-21 gives concentrations of TSP, nitrogen dioxide (NO_x) and SO_2 for areas within the BLM Platte River Resource Area. The Casper monitoring station is approximately 36 miles south of the project area and the Irene Ranch monitoring station is about 50 miles to the east of the project area.

3.7.7 Beaver Creek Alternative

Air quality conditions for this pipeline alternative are the same as existing conditions for the Beaver Creek Project.

3.7.8 Frontier/Casper Alternative

Air quality conditions for this pipeline alternative include the baseline conditions for both the Fontenelle and the Salt Creek project areas.

3.7.9 Exxon Alternative CO_2 Supply

The baseline air quality resources for this alternative are the same as previously described for the Fontenelle Project in Section 3.7.2.

3.7.10 No Action Alternative

The air quality affected environment would be the same for the No Action Alternative as was previously described for the Proposed Actions in Section 3.7.2 through 3.7.6.

3.8 CULTURAL RESOURCES

3.8.1 Introduction

The cultural resources of the project areas are described based on Class I inventories within the field boundaries and within sections which would be crossed by the proposed pipeline routes of the Fontenelle, Beaver Creek, Little Buffalo Basin and Salt Creek projects (Powers Elevation, 1988a-d). A Class I survey reviews and synthesizes existing information about the known cultural resources of these areas (considered the study areas for purposes of this section of the EIS). Sites are noted regardless of land ownership. The purpose is twofold: first, to indicate whether existing data are sufficient to determine whether or not the project will have a significant impact on cultural resources; and second, if a right-of-way is to be issued, to determine where a Class III survey is needed to identify, evaluate and

protect significant cultural resources.

Recommendation for a Class III survey is justified based on the Class I survey, either because the evidence indicates a moderate to high potential for significant cultural resources or there is insufficient survey data to rule out the existence of significant cultural resources.

Archeological sites are evaluated with specific guidelines. Sites are evaluated based upon their eligibility for the National Register of Historic Places (*NRHP*). Regulations have developed a screening process that provides for protection of eligible sites.

National Register guidelines (36 *CFR* 60.4) define four criteria of significance; the guidelines state that: "The quality of significance in American history, architecture, archeology and culture is present in districts, sites, buildings, structures and objects of State and local importance that possess integrity of location, design, setting, materials, workmanship, feeling and association and:

a. That are associated with events that have made a significant contribution to the broad patterns of our history; or

b. That are associated with the lives of persons significant in our past; or

c. That embody the distinctive characteristics of a type, period, or method of construction, or that represent the work of a master, or that possess high artistic values, or that represent a significant and distinguishable entity whose components may lack individual distinction; or

d. That have yielded, or may be likely to yield, information important in prehistory or history."

In Wyoming, sites generally considered eligible for the NRHP are:

- o Rock shelters and caves containing cultural materials;
- o Pottery scatters;
- o Paleo-Indian sites;
- o Communal big game kill sites;
- o *Prehistoric* or proto-*historic* burials;
- o Effigy figures, medicine wheels;
- o Petroglyphs and pictographs; and
- o Multi-component and/or stratified cultural sites, and sites with intact structural remains.

Historical sites which are generally considered eligible are trails, burials, structural remains associated with trails and historic inscription sites.

For the Class I surveys, data were examined from a variety of sources including the files of the Wyoming State Historic Preservation Office (*SHPO*), the Wyoming State Office of BLM, the University of Wyoming, the University of Colorado, the Denver Public Library and the BLM resource area office appropriate for each project.

A Class III inventory was conducted for the Elk Basin Trunk Pipeline route (Powers Elevation, 1988e). This was an intensive pedestrian survey of the route, excluding private property where investigators were denied access (see Appendix 3, Memorandum of Agreement on Cultural Resources for the Bairoil/Dakota Project and Roles and Procedures for the Amoco projects). The Class III survey included a literature review comparable to the Class I surveys described above. The purpose of the Class III survey was to locate, record and evaluate all cultural resources found in a 100-foot-wide corridor (50 feet on both sides of the proposed pipeline centerline).

Table 3-22 summarizes cultural resources identified in both the Class I and Class III surveys for the Pro-

Table 3-22. Cultural Resource Sites Identified in Class I and Class III Surveys. (a)

Type of Site	Fontenelle Class I	Elk Basin Class I	Elk Basin Class III	Beaver Creek Class I	Little Buffalo Class I	Salt Creek Class I
Prehistoric Recorded	88	106	90	126	64	3
Historic Recorded	11	27	21	14	11	12
Historic Unrecorded	8	20		17	28	2
Prehistoric & Historic Recorded	11	18	19	15	13	1
PREHISTORIC						
Lithic scatter/quarry	27	45		53	37	1
Artifacts & features (b)	70	61		78	37	3
Features	1	3		10	3	
Rock Art	1					
HISTORIC						
Homesteads		3				1
Habitation sites					3	
Residential sites					7	
Townsites						2
Urban features						2
Trash scatters/dump	2	2		1	3	
Grave/cemetery	3					
School					2	
Ranching related	8	21			8	
Herding camps	8	18			9	
Irrigation canals/ditches		8			11	
Rock cairn				1	3	
Trail/road	6	6		8		1
Railroad		1				1
Landing strip				1		
Ferry crossing	2			2		
Stage station						
Oil field/wells		2		5	4	5
Pipeline					1	1
Gravel pit					1	
Industrial site						1
Miscellaneous						1

a = Source: Powers Elevation, 1988a-e.
b = and/or fire-cracked rock.

posed Actions. Numbers of sites listed under each project section do not necessarily correspond directly to other numbers in the tables. One site may be both within a field boundary and crossed by the spur or trunk pipeline. Other sites include both prehistoric and historic components.

Table 3-23 indicates the percentage of each project area surveyed and the adequacy of the survey and categorizes sites as eligible, not eligible or of undetermined eligibility.

3.8.2 Fontenelle Project

The Class I inventory revealed 110 cultural properties known within the study area. Of these, 88 are prehistoric sites, 11 have both prehistoric and historic components, and 11 are historical properties.

The majority of prehistoric sites in the study area contain both artifacts and features which are inferred to have been used as habitation and/or food processing. There are 27 *lithic scatters*, inferred to be lithic procurement and/or chipping areas, one single-feature site and one rock art site.

Of the 99 previously recorded sites, 17 are considered eligible to the NRHP. Historic resources in the project area include: the Sarah Whitman/Pioneer Cemetery, Case-Davis Ferry and Ford, Slate Creek Cutoff or the Kinney and Baker-Davis trails, the Opal Wagon Road and several sites used for stock herding activities. Portions of the Opal Wagon Road, Case Road and a road from Slate Creek to the Green River will be crossed by the proposed pipeline gathering system.

3.8.3 Elk Basin Project

The Class III survey for the study area located 151 cultural properties. Of these, 106 are prehistoric sites, 18 contain both prehistoric and historic components and 27 are historical properties.

Of the prehistoric sites, 45 are lithic scatters, 61 contain both artifacts and features and three sites contain only features. Fifteen of the lithic scatters are believed to be lithic procurement sites and the remainder are considered to be knapping stations. One also showed evidence of vegetal processing activities. The 61 locations containing both artifacts and features are considered to have been camping or habitation sites.

Of the 40 historic properties, 21 are related to ranching activities which include stock herding camps and homesteads. The other historical sites include eight irrigation canals, six trails or roads, one railroad bed, one oil field trash dump and two trash scatters.

Thirty-two of the cultural sites (prehistoric and historic) have been evaluated as eligible or provisionally eligible for nomination to the NRHP. The eligible prehistoric sites include two large (about 31,000 and 240,000 square meters) areas of fire-cracked rock, lithic tools and *debitage*. Many of the provisionally eligible prehistoric sites, for which further testing is recommended, are located in depositional environments (e.g., at the toe of a colluvial slope) which indicate a high potential for intact buried materials. The eligible historical sites are eight canals (Sidon, Frannie, St. Joe's, Tatman, Farmer, Bench Bank and Elk-Lovell) and the Bridger Trail.

Associated Projects. Cultural resource data for the Bairoil/Dakota Pipeline are not included on Table 3-22 or 3-23 because they are not available for presentation in the same format. From mileposts 112 to 185, 53 sites are currently known (BLM, 1985a). These include lithic scatters, stone rings, cairns, an

Table 3-23. Cultural Resource Survey Summary. (a)

Project	Area Surveyed	Prehistoric Sites			Historic Sites			Multicomponent Sites		
	% of Area (% Adequate) (b)	Eligible (c)	Not Eligible	Undetermined	Eligible	Not Eligible	Undetermined	Eligible	Not Eligible	Undetermined
Fontenelle								4	3	5
Raptor Field	23 (23)		3	19			2			
Plant Site	50 (50)	1		1						
Access Road	19 (19)	1	1	3						
Gas Gathering	0	2	4	2	2	1	4			
Not at Risk		13	26	24			9			
Elk Basin										
Field										
Pipeline	100 (100) (d)	20	71	0	9	12	0	8	11	0
Not at Risk										
Beaver Creek										
Field	37 (1)	6	55	38	0	2	8	0	8	5
Pipeline	14 (13)	2	4	7	5	4	13	0	0	1
Not at Risk				22 (e)						
Little Buffalo Basin										
Field	70 (0)	0	6	32	0	0	11	1	4	5
Pipeline	4 (4)	0	4	4	0	0	28	1	2	0
Not at Risk			9	14						
Salt Creek										
Field	86 (1)	0	0	3	0	0	13	0	0	1
Pipeline	0	0	0	0	0	0	2	0	0	0
Not at Risk										
Beaver Creek Alternative										
Pipeline	Unknown									
Frontier/Casper Alternative										
Pipeline	Unknown									

a = Source: Class I and Class III surveys by Powers Elevation (1988a-e).
b = To be considered "adequate," both survey methods and recording methods must be adequate.
c = Includes provisionally eligible and eligible with concurrence sites.
d = Does not include areas of potential temporary use permits.
e = Includes eligible and not eligible sites.

historic trash dump, camps and an historic structure. Twenty of these sites are considered eligible for the National Register of Historic Places by the survey archeologists. The pipeline would also cross the Oregon - Mormon National Pioneer Historical Trail (Oregon - Mormon Trail) (in three places between mileposts 131.3 and 133), the Ft. Bridger-Ft. Casper Military Road and the Bridger Emigrant Trail, all of which are considered NRHP eligible. It has not, however, been determined if the crossing areas are contributing segments. The Oregon - Mormon Trail is known to be a two-track road in the crossing area (BLM, 1985a).

3.8.4 Beaver Creek Project

The class I survey for the study area revealed 155 recorded cultural properties. Of the recorded sites, 126 are prehistoric sites, 15 have both prehistoric and historic components and 14 are historical properties.

Of the 141 prehistoric sites with prehistoric components, 53 are lithic scatters, 78 have both artifacts and features and/or fire-cracked rock, and 10 contain features only. The majority of the sites are inferred to have functioned as habitation and/or food processing sites and chipping/knapping stations. Three are considered secondary lithic procurement sites and one is believed to be a possible hunting blind. Of the 141 sites with prehistoric components, six are eligible for nomination to the NRHP and six others have concurrence from the Keeper of the NRHP to be eligible. The majority of eligible sites have hearth features in association with lithics with an inferred function of a camp site. One site is a bell-shaped fire pit.

The historic sites revealed in the Class I survey include: stock herding activities, stage stations, oil fields, homestead claims, an irrigation ditch and trails. The trails include the main branch of the Oregon - Mormon Emigrant Trail; the Rawlins to Fort Washakie Trail and two unnamed trails, which were branches of the Rawlins to Fort Washakie Trail. Previously recorded sites which are eligible for the NRHP include the Kirk Ranch, the Ice Spring Slough Station and the Crooks Gap Stage Station.

3.8.5 Little Buffalo Basin Project

The class I survey of the study area revealed 88 recorded cultural sites and 28 unrecorded sites. Seventy-seven of these sites were prehistoric sites, with 37 containing both artifacts and features and/or fire-cracked rock and three contained features only. The remainder are lithic scatters or quarry sites. The majority of the sites are believed to be lithic procurement areas, while the remainder functioned as habitation sites and/or food processing and lithic chipping areas. Of the 77 recorded sites with prehistoric components, one habitation/lithic scatter site is considered NRHP eligible.

Twenty-five historic sites have been recorded in the study area, of which 13 sites have both prehistoric and historic components and 12 contain only historic remains. These sites include rock cairns, isolated trash scatters, oil well locations, oil camps, habitation sites, ranches, sheepherding camps, irrigation ditches, residential sites, a school and a pipeline. None of the historic sites identified have been formally evaluated as eligible for the NRHP.

3.8.6 Salt Creek Project

Sixteen recorded cultural sites were identified in the Class I survey within the study area. Of these, 3 are prehistoric sites, 1 has both prehistoric and historic components and 12 are historical properties.

Three of the prehistoric sites contain both artifacts and features and the other site is a lithic scatter. None of the four prehistoric sites have been evaluated for NRHP eligibility.

The historic sites that have previously been recorded in the study area include: a trail, an abandoned railroad grade, a homestead, school, townsite, urban features, an industrial site, oil well locations, and an oil field. The majority of the sites are related to development of the Salt Creek Oil Field. None of the sites identified have been evaluated as being eligible for the NRHP. However, a number of these sites may be potentially eligible. These sites could include the historic road to the Powder River Valley, the Town of Midwest, the power plant, the Shannon Well, the Dutch Well, the Stock Well, the Middy Well, the Iba claim and the entire Salt Creek Oil Field.

Associated Projects. From mileposts 185 to 263 of the Bairoil/Dakota Pipeline there are 11 prehistoric known camps and lithic scatters with two sites potentially eligible for the NRHP (BLM, 1985a).

3.8.7 Beaver Creek Alternative

A Class I survey has not been conducted for the Beaver Creek Alternative. While individual site surveys have been conducted along the alignment, a very small portion of the route has been surveyed for cultural resources (Charles, 1988). If this alternative is implemented, Class I and Class III cultural surveys would be conducted.

3.8.8 Frontier/Casper Alternative

The Casper Section of the Frontier/Casper Alternative has not been surveyed for cultural resources. Studies would be required if this alternative is implemented. The route of the Frontier Access Section was studied in conjunction with the construction of the adjacent Rangely CO_2 Pipeline. A Class III survey was conducted before construction and several areas were mitigated during and after construction (Woodward-Clyde Consultants, 1985).

3.8.9 Exxon Alternative CO_2 Supply

A literature/records survey for cultural resources of the Shute Creek Plant site, Riley Ridge Wellfield and part of the feed gas pipeline was conducted in preparation of the Riley Ridge Natural Gas Project DEIS (BLM, 1983c; BLM, 1983f). Three NRHP eligible sites are known from the Shute Creek Plant site. These sites total about 540 acres and all were mitigated during implementation of the Exxon Project.

A total of 137 prehistoric and historic sites of potential significance were located along the one mile right-of-way defined for linear facilities of the Shute Creek Project. The most intense clustering of sites in the vicinity of the feed gas pipeline include: 24 sites in the corridor to Trailblazer Pipeline, 26 in the CO_2 pipeline to Mapco right-of-way long the water line from the Green River (BLM, 1983f). The Sublette Cutoff of the Oregon Trail and the Slate Creek Trail would be crossed by the feed gas trunkline (BLM, 1983f; BLM, 1986e).

Only 16 prehistoric sites were recorded (in 1983) in the wellfield. This number reflects the very small portion of the area that had been surveyed (less than 3 percent). Fourteen historic sites with architectural features (excluding trails) were also identified in the wellfield. The Lander Road is considered a significant historical resource in the wellfield.

3.8.10 No Action Alternative

Cultural resources for the No Action Alternative would be the same as those identified for the Proposed Actions in Section 3.8.2 through 3.8.6.

3.9 MINERAL AND PALEONTOLOGICAL RESOURCES

3.9.1 Introduction

Wyoming is divided into three major physiographic categories: mountains, the high northwestern plateau and basins (Glass and Blackstone, 1987). The Proposed Action and alternative spur and trunk pipeline routes would cross several local physiographic provinces, including the Bighorn Basin, the Owl Creek Mountains, the Wind River Basin, the Casper Arch, the Granite Mountains and the Green River Basin.

Basins hold the majority of the state's mineral resources. Limestone, gypsum, bentonite and phosphate frequently occur in outcrops along the basin margins. Coal and uranium deposits are found at the surface farther out in the basins. Underlying rock units are reservoirs for oil and gas deposits; resources of trona and oil shale are found in the central part of the Green River Basin (Glass and Blackstone, 1987). Other minerals, including limestone, gypsum, crushed rock, jade, sand, gravel, gold, copper, iron ore, phosphate and diamonds, are mined in various regions of Wyoming.

Wyoming is a state with high potential paleontological resource value. Its geologic history has allowed for the development of *fossils*, and the climate provides the erosional power to expose fossils. Investigative work has been conducted throughout the state, and isolated or limited areas with paleontological resources have been identified over wide areas. Many of the geologic formations which would be crossed by the pipelines are known to contain paleontological resources. Sedimentary rock formations along the routes range primarily from late Cretaceous through mid-Tertiary in age and contain a fairly complete record of the prehistoric life of western North America during this time span from approximately 100 to 15 million years ago.

3.9.2 Fontenelle Project

The Fontenelle Plant, gas gathering system and Raptor Field would be constructed in the Green River Basin physiographic province. The Fontenelle Project would be constructed in an area considered to have a high potential for oil and gas development. No oil fields are immediately adjacent to the project area, but there are a number of gas fields. "Sour gas" (natural gas containing hydrogen sulfide) occurs in many of the gas-bearing formations in the Green River Basin. Coal and trona are mined south and east of the project area, although much of the underlying coal is too deeply buried to be mined economically using present technology. No suitable areas for surface mining of oil shale occur in the project's vicinity.

The project would cross five geologic formations or stratigraphic units (Table 3-24). Areas underlain by the Green River and Bridger formations are considered to have a high potential for fossils (BLM, 1978). Both the Kemmerer and Green River resource areas are noted for their paleontological resources.

3.9.3 Elk Basin Project

From southeast to northwest, the Elk Basin Trunk Pipeline would cross the Casper Arch, Wind River Basin and Bighorn Basin physiographic provinces. The pipeline would cross the northeastern corner of the Wind River Coal Basin (mileposts 150 to 172) and the central portion of the Bighorn Coal

Table 3-24. Geologic Formations or Stratigraphic Units Crossed by the Proposed Actions and Alternatives and the Dominant Units in the Wellfields. (a)

Formation/ Stratigraphic Unit	Paleontological Sensitivity	Fontenelle	Elk Basin	Beaver Creek	Little Buffalo Basin	Salt Creek	Beaver Creek Alternative	Frontier/ Casper Alternative	Bairoil/Dakota Milepost 112-185	Bairoil/Dakota Milepost 185-221	Exxon Alternative CO2 Supply
Dune Sand & Loess	Low	x	x					x		x	x
Phosphoria Formation	Moderate		x								
Chugwater Formation	High		x								
Thermopolis Shale	High		x								
Frontier Formation	Moderate		x								
Meeteetse Formation	Moderate		x (a)								
Battle Spring Formation	Moderate			x					x		
Cody Shale	Moderate		x (a)	x	x (a)	x (a)		x	x	x	
Miocene Rocks	Moderate-High			x					x		
Wagon Bed Formation	High		x	x					x		
Wind River Formation	High		x	x			x (a)		x		
Alluvium & Colluvium	Low	x (a)	x	x (a)			x	x	x		x
Mesaverde Formation	Moderate		x (a)		x (a)			x	x	x	
Lance Formation	High		x (a)		x			x	x		
Ft. Union Formation	High		x		x				x		
Tatman Formation	High				x						
Willwood Formation	High				x						

Table 3-24. Continued.

Formation/Stratigraphic Unit	Paleontological Sensitivity	Fontenelle	Elk Basin	Beaver Creek	Little Buffalo Basin	Salt Creek	Beaver Creek Alternative	Frontier/ Casper Alternative	Exxon Bairoil/Dakota Milepost 112-185	Exxon Bairoil/Dakota Milepost 185-221	Exxon Alternative CO2 Supply
Gravel, Pediment & Fan Deposits	Low	x	x		x						x
Green River Formation, Laney Member	High	x									x
Wilkins Peak	High										x
Bridger Formation	High	x (a)						x			x
White River Formation	High			x					x		
Fox Hills Sandstone	High							x			
Crooks Gap Conglomerate	Low								x		
Bug Formation	Low								x		
Wasatch Formation LaBarge and Chapo Members	High										x

a = Formations or stratigraphic units are dominant in the wellfield.

Basin (mileposts 0 to 103). Uranium mining has occurred along the proposed right-of-way, but has declined in recent years due to unfavorable economics. . Within the BLM South Bighorns Resource Management Unit (mileposts 145 - 155), the trunk pipeline would be located adjacent to areas of extensive bentonite claims. No other minerals have been identified in this area. Within the Platte River Resource Area's Management Unit 14, the pipeline would traverse an area with a high oil and gas potential (BLM, 1984c).

The project would cross 14 geologic formations or stratigraphic units, as listed in Table 3-24. Six of these units are of high paleontological sensitivity. Two general areas of paleontological research exist along the route of the proposed Elk Basin CO_2 Trunk Pipeline. The Bighorn Basin, including the general area of mileposts 50 to 76, has had an ongoing history of paleontological interest (BLM, Worland District, File Data). The second area of research is the Lysite/Lost Cabin/Badwater/Arminto area of Natrona County, approximately mileposts 130 to 157 of the proposed trunk pipeline. The Elk Basin Plant and wellfield areas are dominated by Upper Cretaceous Formation of moderate paleontological sensitivity (Table 3-24).

Associated Projects. The Bairoil/Dakota Pipeline would cross the Wind River Coal Basin (mileposts 164 - 180) (Hausel et al., 1979). Zeolite deposits are also found in the vicinity of milepost 160 (BLM, 1986b). The pipeline would be in proximity to oil and gas fields near Crooks Gap (milepost 112), north of the Rattlesnake Hills (milepost 160) and near Powder River (milepost 185) (Stephenson et al., 1984).

The pipeline would cross 12 stratigraphic units. The Wagon Bed, Wind River Lance, Ft. Union and White River formations all have a high paleontological sensitivity. The latter contains vertebrate fossils of national significance (BLM, 1986b).

3.9.4 Beaver Creek Project

The Beaver Creek Project would originate at the Sweetwater Uplift south of Jeffrey City and would run northwest across a portion of the Wind River Coal Basin. Oil and gas production have been significant in the project's vicinity, though production has declined since 1980. There are no active coal mines near the proposed project, but zeolites are mined four miles southwest of Sand Draw near milepost 14. While uranium mining operations have ceased temporarily in almost all of the area's uranium districts (BLM, 1986b), uranium development is currently expanding in the Green Mountain area (BLM, Lander Resource Area, File Data).

The pipeline would cross seven geologic formations or stratigraphic units, as shown in Table 3-24. Three of these are of high paleontological sensitivity. The BLM (1986b) has noted the occurrence of paleontological resources throughout the Lander Resource Area. Marine invertebrate fossils, dinosaur skeletal remains and mammalian remains occur in several geologic formations. The Beaver Creek Plant and wellfield would be constructed predominately in the Wind River Formation (high sensitivity) and Quaternary alluvium/colluvium.

3.9.5 Little Buffalo Basin Project

The proposed Little Buffalo Basin Spur Pipeline would be located in the Bighorn Basin physiographic province. Two gas fields and two oil fields are located near the proposed right-of-way. Two construction aggregate pits, sources of crushed rock, sand, sand and gravel, baked rocks and limestone, are located along Gooseberry Creek.

The spur pipeline would cross seven geologic formations or stratigraphic units, most with high paleontological sensitivity (Table 3-24). The area surrounding the origin station of the proposed Little Buffalo Basin Spur Pipeline has yielded a number of paleontological resources. Areas of known fossil resources occur between mileposts 20 and 35 of the spur pipeline. The plant and wellfield are primarily Cody Shale and Mesaverde Formation, both of moderate sensitivity.

3.9.6 Salt Creek Project

The Salt Creek Spur Pipeline would be constructed northeast of the Casper Arch and west of the Powder River Basin physiographic province. Oil production has declined over the past 12 years in the BLM's Platte River Resource Area. Gas production, however, is expected to increase (BLM, 1984a). The project area does not include economically minable coal. The pipeline would run south of the Black Hills Bentonite Company Mine at Salt Creek, and would be adjacent to six oil fields. The nine-mile pipeline, plant and wellfield would affect the Cody Shale Formation (Table 3-24).

Associated Projects. From Natrona north to the Salt Creek Pipeline origin station (mileposts 185 - 220) the Bairoil/Dakota Pipeline would not cross any significant areas of coal or locatable mineral resources. The pipeline would pass within a few miles of two oil fields at milepost 220 (BLM, 1984a). The pipeline would cross only two geologic formations, neither of which is considered to be of high paleontological sensitivity.

3.9.7 Beaver Creek Alternative

The Beaver Creek Alternative alignment would be constructed in the Wind River Basin physiographic province. The entire alternative alignment would be within the Wind River Coal Basin, adjacent to an existing pipeline. There are no active coal mines in the vicinity of the alternative. Significant uranium deposits occur in the Copper Mountain Uranium District. A number of oil and gas fields are near the proposed pipeline route.

The alternative pipeline alignment would cross two geologic formations or stratigraphic units (Table 3-24). The BLM has noted the occurrence of paleontological resources throughout the Lander Resource Area, including marine invertebrate fossils, dinosaur skeletal remains and mammalian remains. The Wind River Formation has been characterized as containing vertebrate fossils of national significance (BLM, 1986b).

The Beaver Creek Alternative alignment would also affect the environment described for the Beaver Creek Trunk Pipeline and for most of the Elk Basin Trunk Pipeline. The Beaver Creek Alternative alignment would not, however, affect the Lysite/Lost Cabin /Badwater/Arminto area of paleontological interest in Natrona County.

3.9.8 Frontier/Casper Alternative

The Frontier/Casper Alternative would involve pipeline construction in two areas. The Frontier Section would be constructed in the Green River Basin physiographic province. Several oil fields are in the vicinity of the Frontier Access Section origin. Trona is mined approximately 15 miles east of the alternative project area. The pipeline would cross the Bridger Formation following the existing Rangely CO_2 Pipeline west of Highway 372.

The Casper Section would be constructed in the Powder River Coal Basin, and would be adjacent to a number of oil and gas fields. The Casper Section would cross six geologic formations or stratigraphic units (Table 3-24).

3.9.9 Exxon Alternative CO_2 Supply

The Exxon Project is located in the Green River Basin physiographic province. The plant site and feed gas trunkline are within the Green River Coal region but are not underlain by thick or abundant coal. The plant site and about half of the pipeline are also underlain by oil shale bearing strata (Hausel et al., 1979). Several gas fields are located along the feed gas pipeline route (BLM, 1987d). The feed gas trunkline would cross seven stratigraphic units, four of which are considered to be of high paleontological sensitivity (Table 3-24).

3.9.10 No Action Alternative

Mineral and paleontological resources for the No Action Alternative would be the same as those described for Amoco's Proposed Actions in Sections 3.9.2 through 3.9.6.

3.10 VISUAL RESOURCES

3.10.1 Introduction

Visual Resource Management (VRM) classes are described in this section for each of the projects and their alternatives. The VRM classification combines an evaluation of visual quality, visual sensitivity of the area and view distances. During preparation of this DEIS, visual resource management criteria were applied to all lands, regardless of ownership. The objectives of the VRM classes are as follows (BLM, 1986d):

- Class I: To preserve the existing character of the landscape; does not preclude very limited management activity but the level of change to the characteristic landscape should be very low and must not attract attention.
- Class II: To retain the existing character of the landscape; the level of change should be low; management activities may be seen but should not attract the attention of the casual observer; any changes must repeat the basic elements of form, line color and texture found in the predominant natural features of the landscape.
- Class III: To partially retain the existing character of the landscape; the level of change can be moderate; management activities may attract attention but should not dominate the view; changes should repeat the basic elements found in the predominant natural features.
- Class IV: To provide for management activities which require major modification of the existing character of the landscape; the level of change may be high and management activities may dominate the view and be the major focus of viewer attention.

Table 3-25 lists by milepost or general location the VRM classes for the proposed projects and their alternatives.

3.10.2 Fontenelle Project

The majority of the project area is designated either Class III or IV (BLM, 1986a; BLM, 1978). The gas gathering system would be constructed in a Class IV near the plant and in a Class II area where it crosses and parallels the Green River. Within both the Kemmerer and Green River resource areas, the shore of Fontenelle Reservoir (about a one-mile corridor) and the Green River are Class II VRM areas (BLM, 1986e). All but about six miles of the gas gather-

Table 3-25. Visual Resource Designations for the Proposed Actions and Alternatives.

Project Component/ Location by Milepost	Visual Resource Manangement Class	Description
FONTENELLE		
Plant Site	IV	
CO2 Wellfield	IV	Majority
CO2 Wellfield and 14 -16	II	One-mile corridor from shore of Fontenelle Reservoir
Gas Gathering System		
0 - 8	IV	Gas Processing plant site and southern part of gas gathering system
8 - 14 and W7	II	One-mile corridor along the Green River; river crossing is adjacent to Seedskadee National Wildlife Refuge
4 - 8 and W0 - W7	III	Dodge Rim/State Creek area west of the Green River
ELK BASIN		
Plant Site and Wellfield	IV	Elk Basin oil field
0 - 17	IV	Elk Basin field to Highway 114 area; proposed utility corridor
17 - 20	III	Shoshone River area; proposed utility corridor
20 - 37	IV	Park - Bighorn County Line agricultural area and south to Emblem Bench; proposed utility corridor
37 - 42	III	Emblem Bench area along Highway 14-16-20; proposed utility corridor
42 - 47	IV	Bench Canal south across Greybull River
47 - 56	III	Sheep Mountain area
56 - 80	IV	Sheep Mountain area to Bighorn River corridor
80 - 87.5	III	Bighorn River Valley; designated Linear right-of-way
87.5 - 88	II	Vicinity of Cedar Mountain WSA; designated Linear right-of-way
88 - 162	IV	From vicinity of Bighorn River to Highway 20-26 corridor
162 - end	III	Parallel to Highway 20-26; partially in designated general corridor
BEAVER CREEK		
Plant Site and Wellfield	IV	Beaver Creek oil field
0 - 12	IV	Includes Beaver Creek and Sand Draw oil fields
12 - 13	II	Beaver Divide
13 - 24	IV	
24 - 26	II	Sweetwater River
26 - 29	IV	
29 - 31	II	Ice Slough
31 - 43	IV	Includes Crooks Gap oil field and the Western Nuclear Uranium Mine
43 - end		
LITTLE BUFFALO BASIN		
Plant Site and Wellfield	IV	Little Buffalo Basin oil field
0 - 4	IV	Little Buffalo Basin oil field
4 - 12	III	From the field to vicinity of Hillbilly Rim
12 - 15	IV	Between Hillbilly Rim and Blue Ridge
15 - 34	III	Majority of route along Gooseberry Creek; Class II area north of the pipeline in badlands area
34 - end	IV	Origin Station

Table 3-25. Continued.

Project Component/ Location by Milepost	Visual Resource Manangement Class	Description
SALT CREEK		
Plant Site and Wellfield	IV (a)	Salt Creek oil field
0 - 5	IV (a)	Salt Creek oil field
5	III (a)	Interstate 25
5 - 9	IV (a)	Interstate westward
BEAVER CREEK ALTERNATIVE (entire route)	IV	Excludes the Wind River Indian Reservation
FRONTIER/CASPER ALTERNATIVE		
FRONTIER ACCESS SECTION		
0 - 12	IV	
12 - 24	III	Along Highway 372
CASPER SECTION		
0 - 6	IV (a)	Salt Creek oil field
6 - 28	III	Interstate 25; most in designated general corridor
28 - 37	IV	
37 - end	III	Corridors along Interstate 25 and Highway 20-26; most in designated general corridor
EXXON BAIROIL/DAKOTA ALTERNATIVE		
112 - 113	V	Crooks Gap; Western Nuclear Uranium Mine
113 - 118	II	Green Mountain
118 - 120	III	
120 - 129	IV	
129 - 133	III	Sweetwater River; Oregon - Mormon Trail managed as Class I; crosses Highway 287 about 0.5 miles from Split Rock Interpretive Center.
133 - 143	II	Sweetwater Rocks
143 - 147	III	
147 - 161	IV	Keester Basin
159 - 163	III	Rattlesnake Hills
163 - 180	IV	
180 - 190	III	Corrior along Highway 20-26
190 - 221	IV	Includes Salt Creek Area of critical environmental concern
EXXON ALTERNATIVE CO2 SUPPLY		
Plant Site	IV	
0 - 38	IV	
Wellfield	III, IV	Most of field is Class III - Wyoming Range.

a = No VRM classes designated for this area. These classes are inferred from surrounding area.

ing system would follow revegetated pipeline disturbance or roads.

The Fontenelle Plant would be constructed in a Class IV area adjacent to a visually similar industrial facility (Exxon's Shute Creek Plant). The wellfield would be located in rolling sagebrush/grassland terrain on benches about 200 feet above the reservoir level. The wellfield would be constructed in a Class IV area except for the one mile corridor along the reservoir. The Raptor Field is currently undeveloped except for one exploratory well, but existing dirt roads provide access to most of the Field.

3.10.3 Elk Basin Project

From the origin station near Powder River in Natrona County, the proposed trunk pipeline would be routed to the Elk Basin Field adjacent to revegetated pipeline corridors except where the route has been modified to avoid cultural resources. The majority of the trunk pipeline would be constructed in Class III or Class IV areas. Within the Platte River Resource Area, the proposed pipeline route would follow a designated general corridor (BLM, 1984a). The only Class II area along the Elk Basin route is south of the Bighorn River near the Cedar Mountain Wilderness Study Area. The pipeline would be constructed in a designated utility corridor as it crosses the river at this location (BLM, 1987b). The entire river, except for the designated utility corridor, is an avoidance area (BLM, 1987b). North of the Greybull River, in the Cody Resource Area, the pipeline would follow a proposed corridor (BLM, 1988).

The plant and wellfield facilities would be constructed in areas of existing oil field disturbance that are designated Class IV (BLM, 1988).

Associated Projects. After originating at milepost 112 in the Class IV Crooks Gap area, the Bairoil/Dakota Pipeline would cross VRM Class II, III and IV areas (Table 3-25) (BLM, 1984a; BLM, 1986b). Green Mountain and the Sweetwater Rocks areas are designated Class II. The Sweetwater River, parts of the Rattlesnake Hills and a corridor along Highway 20-26 are Class III areas. Within the Sweetwater River area, the Oregon - Mormon Trail is managed as a Class I area. The pipeline would cross Highway 287 about 0.5 miles from the Split Rock Interpretive Site (BLM, 1985a). Throughout this area, the pipeline would follow a revegetated pipeline corridor.

Since construction of the Frontier Pipeline and preparation of the Bairoil/Dakota EIS, the Lander Resource Area has designated the Oregon - Mormon Trail and the Sweetwater Rocks as avoidance areas for rights-of-way (BLM, 1986b). The pipeline would not follow any of the corridors designated in the Platte River Resource Area (BLM, 1986b; BLM, 1984a).

3.10.4 Beaver Creek Project

The entire Beaver Creek Trunk Pipeline would be constructed adjacent to revegetated pipeline corridors. Most of the pipeline would be constructed in areas designated Class IV (BLM, 1986b). Areas designated as Class II include the Sweetwater River, the vicinity of Ice Slough and Beaver Divide which is adjacent to the Class IV designated Sand Draw Oil Field. The route of the Oregon - Mormon Trail is managed as a VRM Class I area. The Lander Resource Area has not designated utility corridors but the Oregon - Mormon Trail is a right-of-way avoidance area.

The plant and wellfield-related facilities would all be constructed adjacent to existing disturbance in a Class IV area.

3.10.5 Little Buffalo Basin Project

The proposed Little Buffalo Basin Spur Pipeline would be routed adjacent to an abandoned pipeline and along a state highway. Most of the pipeline route is designated as Class III with small areas of Class IV (see Table 3-25) (BLM, 1982b). About half of the pipeline route would follow State Highway 431 and the agricultural valley along Gooseberry Creek. The badlands area in the South Fifteenmile Creek drainage just north of the pipeline route is designated Class II.

The plant and wellfield facilities would be constructed in areas of existing oil field disturbance in a Class IV area.

3.10.6 Salt Creek Project

Most of the 9 miles of proposed route would either follow an existing road (5.5 miles) or would be constructed within the Salt Creek Field (2 miles). Most of the pipeline route would be constructed within the Salt Creek Area of Critical Environmental Concern which was excluded from visual resource management designation (BLM, 1984a). Extrapolation from VRM classes designated for the vicinity, however, are included in Table 3-25. The pipeline route east of the Interstate (mileposts 0 to 5) would be constructed in an area designated as a general corridor (BLM, 1984a).

The plant and wellfield facilities would all be constructed in an intensely developed area designated as a general corridor area. The wellfield has not been given a VRM Class designation but is comparable to a Class IV.

Associated Projects. Except for the Class III corridor along Highway 20-26, the Bairoil/Dakota Pipeline from mileposts 185 to 221 would be constructed in a Class IV area (Table 3-25). It would not, however, follow any of the general corridors designated in the Platte River Resource Area (BLM, 1984a).

3.10.7 Beaver Creek Alternative

The entire Beaver Creek Alternative route is designated VRM Class IV, except in the Wind River Indian Reservation which has not been classified. The proposed route would be constructed adjacent to reclaimed pipelines. The Beaver Creek Alternative would also affect the environment of the Beaver Creek Trunk Pipeline which is Class IV, except for the Beaver Divide and the Oregon - Mormon Trail. The environment described above for the Elk Basin Trunk Pipeline would also be affected except for the area from milepost 132 to the origin station (milepost 177). This area is Class IV except for the corridor along Highway 20-26 which is Class III.

3.10.8 Frontier/Casper Alternative

Both sections of this alternative are designated VRM Class III and Class IV. The Frontier Section would follow the existing Rangely CO_2 Pipeline for about 24 miles to where the Rangely Pipeline crosses the Frontier Pipeline. The Frontier Section would cross the Pony Express Route (milepost 12) and the Oregon - Mormon Trail (milepost 17). The route would parallel Wyoming State Highway 372 for about 12 miles.

The Casper Section departs from the Frontier Pipeline in a VRM Class III area northwest of Casper. Except for about nine miles of pipeline (which is designated Class IV), the alternative route would remain in a Class III corridor which follows Interstate 25 north to the Salt Creek Field. The field is not designated but is inferred to be equivalent to a Class IV. The route would follow a designated general corridor except in the

vicinity of Casper where the line was routed to the west of the corridor to avoid residential areas.

3.10.9 Exxon Alternative CO_2 Supply

Phase II of the Shute Creek Gas Plant would be constructed in a Class IV area. The entire feed gas trunkline and the southeastern part of the wellfield would also be Class IV. Most of the wellfield is, however, in a Class III area on the east flank of the Wyoming Range.

3.10.10 No Action Alternative

The visual resource affected environment for the No Action Alternative would be the same as described for Amoco's Proposed Actions in Sections 3.10.2 through 3.10.6.

3.11 RECREATION

3.11.1 Introduction

The affected environment for recreation includes not only the areas directly affected by the construction and operation of the pipelines, plants and wellfield facilities, but also the areas which could be indirectly affected through an increase in construction-related populations. The recreation study area is defined as all land within a 70-mile radius of the destination community for the *inmigrant* workforce for worker fishing, and within a 50-mile radius for other dispersed recreation. Major recreation areas most frequently visited by residents of the workforce destination counties are listed in Table 3-26.

Recreation Opportunity Spectrum (ROS). Not all of the BLM resource areas in the project area have been analyzed according to the *ROS* system (e.g., semiprimitive nonmotorized, semiprimitive motorized, roaded natural, roaded modified, etc.). The Recreation Technical Report uses the ROS to characterize areas of potential direct impact in those BLM resource areas where the analysis has been completed, and in other areas uses visual analyses as an approximation. In plant and field areas with existing oil development, ROS classification is typically roaded modified. Proposed pipelines in existing corridors most often pass through semiprimitive motorized or roaded natural areas.

Fishing and Hunting. Fishing statistics by drainage area appear in Table 3-27. Table 3-28 presents aggregate hunting statistics for the hunt areas within a 50-mile radius of the busing destination city for each project. Table 3-29 presents similar statistics for hunt areas intercepted by project components.

National Natural Landmarks. No designated landmarks occur within one mile of any project Proposed Action component.

Wilderness Areas and Wilderness Study Areas. No project component would be located within five miles of any Wilderness Area. The Elk Basin Trunk Pipeline would be less than five miles from the Sheep Mountain, Red Butte and Cedar Mountain wilderness study areas.

Wild and Scenic Rivers. No project component, except the Exxon Alternative CO_2 Supply Feed Gas Trunkline, would be located within one mile of any 1) existing component of the National System of *Wild and Scenic Rivers*, 2) river listed on the National Inventory of significant free flowing rivers, or 3) river identified for further study under Section 5(a) of the Wild and Scenic Rivers Act (National Park Service, 1982). Fontenelle Creek is on the National Park Service list as a potential wild and scenic river, but the Pinedale Resource Management Plan does not recommend further study (BLM, 1987d).

Table 3-26. **Recreation Areas Most Visited by Project County Residents. (a)**

Recreation Area	Primary Outdoor Activities	Residents' Ranking by Frequency of Visitation				
		Fremont	Natrona	Park	Sweet-water	Washakie
Alcova Reservoir	Fishing, power boating, sightseeing, swimming, camping		1			
Bighorn Canyon National Recreation Area	Sightseeing, fishing, swimming, hunting, camping			4		
Bighorn National Forest	Sightseeing, camping, fishing, hunting, picnicking		4	5		2
Bridger-Teton National Forest	Hunting, sightseeing, camping, fishing, downhill skiing				2	
Buffalo Bill State Park	Sightseeing, fishing, camping, picnicking, power boating			3		
Flaming Gorge National Recreation Area	Fishing, sightseeing, power boating, picnicking, camping				1	3&4
Fontenelle Reservoir	Fishing, sightseeing, picnicking, nonmotor boating, camping				4	
Grand Teton National Park	Sightseeing, hunting, fishing, camping, swimming, day hiking	3&4				5
Hot Springs State Park	Swimming, sightseeing, picnicking, camping, golf	2	3			1
Ocean Lake	Fishing, swimming, sightseeing, waterskiing, nonmotor boating	3&4				
Pathfinder Reservoir	Fishing, sightseeing, camping, power boating, hunting		2			
Pinedale Area Lakes	Fishing, camping, hunting, sightseeing, picnicking				3	
Shoshone National Forest	Sightseeing, hunting, camping, fishing, picnicking	5		1		
Sinks Canyon State Park	Sightseeing, fishing, picnicking, day hiking, camping	1			5	
Yellowstone National Park	Sightseeing, camping, fishing, day hiking, snowmobiling		5	2		3&4

a = Source: 1985 Wyoming State Comprehensive Outdoor Recreation Plan: Technical Report. Wyoming Recreation Commission, Planning Section. Cheyenne: 1985.

Table 3-27. Baseline Fishing Pressure within a 70-mile Radius of Destination Cities. (a)

	Est. Supply 1986	Baseline Fishing Pressure 1986	Baseline Fishing Pressure Peak Year	Objective 1992
FONTENELLE: Green River (peak, 1990) Fishing Pressure, Green River Drainage (Fisherman Days)	1,636,850	680,276	651,836	717,121
ELK BASIN: Powell (peak, 1990) Fishing Pressure, Big Horn - Wind R. and Yellowstone - Clarks Fork Drainages (Fisherman Days)	2,119,424	678,915	688,790	716,285
BEAVER CREEK: Riverton (peak, 1992) Fishing Pressure, Big Horn - Wind River & North Platte River Drainage (Fisherman Days)	4,245,988	2,041,101	2,158,550	2,153,944
LITTLE BUFFALO BASIN: Worland (peak, 1993). Fishing Pressure, Big Horn - Wind River and Yellowstone - Clarks Fork Drainages (Fisherman Days)	2,119,424	678,915	698,567	716,285
SALT CREEK: Casper (peak, 1994) Fishing Pressure, Tongue - Powder River and North Platte River Drainages (Fisherman Days)	2,647,508	1,775,418	1,852,905	1,875,349

a - Source: 1986 Baseline from Wyoming Game and Fish Department (1987); Peak Year Baseline is the product of the county population and the fishing pressure to population ratio. For additional source information, please see Socioeconomic Conditions and Recreation Technical Reports. All figures are in fisherman days, including supply. Peak year is the year in which project plant and field workers and their related population would peak. Objectives are the fishing pressure objectives set for 1992 by the Wyoming Game and Fish Department. Drainage areas generally correspond to those on the Wyoming Game and Fish Department's 1987 Trout Map, except that on the map, the Platte River Drainage Area is called the North Platte River Drainage (Area 5) and the Wind - Big Horn River Drainage Area includes both the Wind - Big Horn (Area 2) and Yellowstone - Clarks Fork (Area 8) drainages (see Wildlife section).

Table 3-28. **Hunting Statistics for Hunt Areas in the Vicinity of Project Destination Cities. (a)**

City & Animal	Population Objective	1986 Population	% of Obj.	Hunter Objective	1986 Hunters	% of Obj.	Recreation Objective	1986 Recreation	% of Obj.	Harvest Objective	1986 Harvest	% of Obj.	Hunter Expenditures
GREEN RIVER													
Antelope	49,500	57,078	115.3%	11,600	7,264	62.6%	21,390	17,173	80.3%	10,345	7,760	75.0%	$1,934,119
Mule Deer	85,200	97,506	114.4%	36,487	21,484	58.9%	139,920	85,965	61.4%	14,980	6,267	41.8%	$5,831,563
Elk	9,617	7,916	82.3%	7,925	6,551	82.7%	37,700	33,389	88.6%	1,915	1,271	66.4%	$2,680,194
TOTAL	144,317	162,500	112.6%	56,012	35,299	63.0%	199,010	136,527	68.6%	27,240	15,298	56.2%	$10,445,876
POWELL													
Antelope	11,350	8,303	73.2%	2,810	1,288	45.8%	5,000	3,228	64.6%	2,350	1,069	45.5%	$361,887
Mule Deer	56,300	60,089	106.7%	28,318	18,692	66.0%	80,101	64,086	80.0%	12,020	9,759	81.2%	$4,510,312
Elk	15,350	15,534	101.2%	15,405	11,142	72.3%	61,165	61,842	101.1%	3,800	2,901	76.3%	$5,982,821
TOTAL	83,000	83,926	101.1%	46,533	31,122	66.9%	146,266	129,156	88.3%	18,170	13,729	75.6%	$10,855,020
RIVERTON													
Antelope	56,350	60,896	108.1%	12,190	8,557	70.2%	21,693	19,413	89.5%	10,777	9,965	92.5%	$2,258,206
Mule Deer	58,300	52,815	90.6%	22,411	13,328	59.5%	57,945	34,297	59.2%	11,920	7,417	62.2%	$2,439,284
Elk	8,567	8,837	103.2%	6,425	4,931	76.7%	28,863	24,556	85.1%	1,772	1,153	65.1%	$2,083,072
TOTAL	123,217	122,548	99.5%	41,026	26,816	65.4%	108,501	78,266	72.1%	24,469	18,535	75.7%	$6,780,562
WORLAND													
Antelope	22,750	21,194	93.2%	6,178	4,484	72.6%	12,961	11,594	89.5%	5,247	4,531	86.4%	$1,655,349
Mule Deer	111,100	107,589	96.8%	45,674	34,795	76.2%	138,351	118,141	85.4%	22,065	19,414	88.0%	$8,783,602
Elk	13,450	13,174	97.9%	14,605	10,400	71.2%	57,994	58,471	100.8%	3,407	2,616	76.8%	$5,577,277
TOTAL	147,300	141,957	96.4%	66,457	49,679	74.8%	209,306	188,206	89.9%	30,719	26,561	86.5%	$16,016,228
CASPER													
Antelope	161,600	140,479	86.9%	45,207	24,106	53.3%	83,530	68,656	82.2%	41,240	27,656	67.1%	$11,104,599
Mule Deer	108,600	85,040	78.3%	37,766	19,522	51.7%	94,000	50,165	53.4%	21,882	11,687	53.4%	$4,062,681
Elk	6,475	4,775	73.7%	5,105	4,146	81.2%	21,144	23,437	110.8%	1,386	1,135	81.9%	$2,087,478
TOTAL	276,675	230,294	83.2%	88,078	47,774	54.2%	198,674	142,258	71.6%	64,508	40,478	62.7%	$17,254,758

a - Source: Wyoming Game and Fish Department (1987).

Table 3-29. Summary of Hunt Areas Intercepted by Proposed Actions and Alternatives.

Project and Animal	Animal Population			Hunters			Recreation Days			Harvest		
	Objective	1986	%	Objective	1986	%	Objective	1986	%	Objective	1986	%
FONTENELLE												
Antelope	41,800	48,192	115.3%	10,235	5,261	51.4%	21,575	13,013	60.3%	9,050	5,178	57.2%
Mule Deer	50,500	48,824	96.7%	19,000	11,113	58.5%	85,000	54,310	63.9%	7,250	2,725	37.6%
Elk	4,567	4,222	92.4%	4,150	3,432	82.7%	19,800	19,098	96.5%	950	611	64.3%
TOTAL	96,867	101,238	104.5%	33,385	19,806	59.3%	126,375	86,421	68.4%	17,250	8,514	49.4%
ELK BASIN												
Antelope	41,500	32,373	78.0%	11,709	5,721	48.9%	19,248	15,314	79.6%	10,437	6,299	60.4%
Mule Deer	55,800	54,243	97.2%	21,272	16,210	76.2%	54,951	46,752	85.1%	11,465	10,479	91.4%
Elk	2,700	4,371	161.9%	1,200	1,356	113.0%	5,589	5,211	101.2%	726	735	101.2%
TOTAL	100,000	90,987	91.0%	34,181	23,287	68.1%	79,788	67,277	84.3%	22,628	17,513	77.4%
BEAVER CREEK												
Antelope	27,100	29,839	110.1%	5,302	4,520	85.3%	7,545	9,209	122.1%	4,800	5,817	121.2%
Mule Deer	16,700	15,262	91.4%	6,208	4,842	78.0%	16,000	10,368	64.8%	3,400	2,057	60.5%
Elk	500	431	86.2%	260	225	86.5%	1,300	975	75.0%	130	126	96.9%
TOTAL	44,300	45,532	102.8%	11,770	9,587	81.5%	24,845	20,552	82.7%	8,330	8,000	96.0%
LITTLE BUFFALO BASIN												
Antelope	8,400	4,116	49.0%	1,500	974	64.9%	3,000	2,712	90.4%	1,200	856	71.3%
Mule Deer	14,100	11,655	82.7%	4,714	3,186	67.6%	13,700	9,954	72.7%	2,740	1,863	68.0%
Elk	1,800	2,246	124.8%	1,390	1,404	101.0%	5,200	6,618	127.3%	400	269	67.3%
TOTAL	24,300	18,017	74.1%	7,604	5,564	73.2%	21,900	19,284	88.1%	4,340	2,988	68.8%
SALT CREEK												
Antelope	12,000	5,289	44.1%	3,000	1,509	44.1%	4,320	4,157	44.1%	2,700	1,872	44.1%
Mule Deer	6,500	4,454	68.5%	2,605	452	68.5%	5,500	1,295	68.5%	1,250	372	68.5%
Elk	None											
TOTAL	18,500	9,743	52.7%	5,605	1,961	35.0%	9,820	5,452	55.5%	3,950	2,244	56.8%
BEAVER CREEK ALTERNATIVE												
Antelope	7,100	9,123	128.5%	1,307	1,486	113.7%	2,070	2,695	130.2%	1,150	1,821	158.3%
Mule Deer	2,600	2,198	84.5%	1,100	586	53.3%	1,800	1,146	63.7%	600	155	25.8%
Elk	None											
TOTAL	9,700	11,321	116.7%	2,407	2,072	86.1%	3,870	3,841	99.3%	1,750	1,976	112.9%
FRONTIER/CASPER ALTERNATIVE												
Antelope	20,000	11,969	59.8%	5,356	2,538	47.4%	8,195	6,552	80.0%	4,850	3,035	62.6%
Mule Deer	50,000	44,363	88.7%	14,985	6,037	40.3%	55,140	24,261	44.0%	7,700	2,212	28.7%
Elk	3,075	2,722	88.5%	2,465	2,340	94.9%	11,000	13,277	120.7%	620	476	76.8%
TOTAL	73,075	59,054	80.8%	22,806	10,915	47.9%	74,335	44,090	59.3%	13,170	5,723	43.5%

a = Source: Wyoming Game and Fish Department (1987a).

3.11.2 Fontenelle Project

The 50-mile radius recreation study area centered in the City of Green River includes parts of the BLM's Kemmerer and Green River resource areas, which provide diverse dispersed recreation opportunities, both on BLM lands and elsewhere (e.g., Fossil Butte National Monument, Bridger-Teton National Forest, Lake Viva Naughton, Fontenelle Reservoir and the Wasatch National Forest). The Green River south of Fontenelle Dam is the only Class I trout stream in the 70-mile radius fishing study area, and is heavily used (O'Donnell, 1987). Flaming Gorge Reservoir provides year-round quality fishing for brown and rainbow trout, and is stocked with trout and bass. Fly fishing is excellent on streams such as Sheep Creek and Carter Creek, which feed into the reservoir.

The proposed gas gathering system would cross areas which were rated low, medium and high in recreation potential in the Kemmerer Resource Management Plan DEIS (BLM, 1985b). In general, areas of highest recreation potential were adjacent to Fontenelle Reservoir and the Green River. No undeveloped areas with high use potential have been identified in the project area. The plant would be in an area of low recreation potential, while the field facilities would be within the Fontenelle Reservoir recreation area.

Fontenelle Reservoir. The most popular activities in this area include fishing and boating. Recreation use totaled 25,000 visitor days in 1986, down from 74,000 visitor days in 1983, before the reservoir level was lowered. Use levels have not justified expansion of facilities, but some improvements are planned prior to refilling of the reservoir in 1989. The reservoir has the potential to attract a maximum of 70,000 visitors annually after refilling of the reservoir and return of a quality fishery (O'Donnell, 1987).

Seedskadee National Wildlife Refuge. The U.S. Fish and Wildlife Service maintains the 11,000-acre Seedskadee Refuge, which follows the Green River south from a point 5 miles below Fontenelle Dam to within 25 miles of the City of Green River. The area provides opportunities for fishing, hunting and wildlife observation.

3.11.3 Elk Basin Project

The 50-mile radius recreation study area centered in the City of Powell includes parts of the BLM Cody, Billings, Grass Creek and Washakie resource areas. No Class I or II trout streams are in the Elk Basin Field or the proposed pipeline right-of-way. Class III streams crossed or in the immediate vicinity of project components include Polecat Creek, Bitter Creek, the Shoshone River and the Bighorn River.

Associated Projects. The most important elements of the recreation environment that could be directly affected by construction of the Bairoil/Dakota Pipeline from mileposts 112 - 185 are Green Mountain (milepost 115), the Oregon - Mormon Trail (milepost 133) and the Sweetwater Rocks Wilderness Study Areas. The Sweetwater River is a Class III trout stream.

3.11.4 Beaver Creek Project

The 50-mile radius recreation study area centered in the City of Riverton is almost entirely in the Lander Resource Area. No Class I or II trout streams are in the Beaver Creek Field or the proposed pipeline right-of-way. The pipeline would cross two Class III streams: the Sweetwater River and Crooks Creek.

3.11.5 Little Buffalo Basin Project

The 50-mile radius recreation study area centered in the City of Worland is mostly in the BLM Grass Creek and Washakie resource areas, with portions in the Lander and Cody resource areas. No Class I, II or III trout streams would be crossed by the pipeline. Class I streams in the 70-mile radius fishing study area include the Middle Fork of the Powder River, the North Fork of the Shoshone River, the Tongue River and the Wind River. The area also includes ten Class II and numerous Class III trout streams.

3.11.6 Salt Creek Project

Most of the 50-mile radius recreation study area centered in the City of Casper is in the BLM Platte River Resource Area, with a small portion in the Great Divide Resource Area. Between 1974 and 1981, recreation use in the Platte River Resource Area increased 757 percent at developed sites (to 117,000 visitor days in 1981) and 48 percent on undeveloped lands (to 479,000 visitor days in 1981) (BLM, 1984a). No Class I, II or III trout streams would be crossed by the pipeline. The only Class I trout streams in the 70-mile radius fishing study area are the Middle Fork of the Powder River and the portions of the North Platte north of Alcova Reservoir and between Seminoe Reservoir and Pathfinder Reservoir.

Associated Projects. There are no major recreation resources that would be directly affected during construction of the Bairoil/Dakota Pipeline from mileposts 185 to 221.

3.11.7 Beaver Creek Alternative

The alternative alignment section would cross part of Boysen State Park and about four miles of the proposed Lysite Badlands *National Natural Landmark*. This alternative alignment would also affect the environment described for the Beaver Creek Trunk Pipeline and the Elk Basin Trunk Pipeline.

3.11.8 Frontier/Casper Alternative

The Frontier Access Section of the proposed pipeline would be in the BLM Green River Resource Area. The recreation study area for this section is the same as for the Fontenelle Project. The Frontier Access Section would cross part of the Seedskadee National Wildlife Refuge and two historic trails.

The Casper Section would be in the Platte River Resource Area. The recreation study area for plant and field workers and Casper Section pipeline workers would be the same as the Salt Creek Project.

3.11.9 Exxon Alternative CO_2 Supply

The affected environment of Phase II of the Shute Creek Gas Plant would include the area described above for the Fontenelle Project with the study areas centered on the Town of Green River. Since the Exxon project would support a man-camp at the plant construction site and require drill crews for an estimated 20 wells, the affected environment would also extend northward to include the Wind River and Wyoming Mountain ranges, the Lake Mountain Wilderness Study Area, Scab Creek Primitive Area, and the Bridger, Popo Agie and Fitzpatrick wilderness areas (Exxon, 1985; BLM, 1983c). The feed gas trunkline would cross Fontenelle Creek, which is on the National Park Service list of potential wild and scenic rivers.

3.11.10 No Action Alternative

The affected environment for recreational resources for the No Action Alternative would be the same as those described for the Proposed Actions in Sections 3.11.2 through 3.11.6.

3.12 WILDERNESS RESOURCES

3.12.1 Introduction

The affected environment for wilderness resources is that which could be directly affected by Proposed Action components or alternatives. For this DEIS, these resources are defined as designated Wilderness Areas (WA) or *Wilderness Study Areas (WSA)* within five miles of the proposed projects and their alternatives (BLM, 1986g).

3.12.2 Fontenelle Project

There are no wilderness resources within five miles of the Fontenelle Project.

3.12.3 Elk Basin Project

The proposed Elk Basin Trunk Pipeline would pass in close proximity to three WSA's: Sheep Mountain and Red Butte in the Grass Creek Resource Area (BLM, 1987c) and Cedar Mountain in the Washakie Resource Area (BLM, 1986h). Figure 3-2 depicts the location of these WSA's in relation to the proposed pipeline route.

Sheep Mountain WSA is located approximately 18 miles west of the Town of Greybull and south of the Greybull River. For about one mile, the Elk Basin Trunk Pipeline would follow a dirt road which forms the northeast boundary of the WSA. Other portions of the pipeline (mileposts 50 to 58) are within 0.5 to 1.5 miles of the eastern border of Sheep Mountain WSA.

Red Butte WSA is located approximately 12 miles northwest of Worland in the Fifteenmile Creek drainage. The area is about 2.5 miles southeast of the Sheep Mountain WSA. The proposed pipeline route would pass between the two WSA's in the vicinity of Corral Creek (milepost 59) and then roughly parallels the western boundary of the Red Butte WSA approaching within 1.5 miles of the boundary at milepost 61.

The Cedar Mountain WSA is located east and northeast of the Town of Kirby along the east side of the Bighorn River. The proposed Elk Basin Trunk Pipeline route would adjoin the WSA near milepost 88 and would be constructed within one mile of the northeast border of the WSA between mileposts 87 and 91.

The BLM has proposed that no acreage in the three WSA's adjacent to the proposed Elk Basin Trunk Pipeline route be recommended for inclusion in the National Wilderness Preservation System (BLM, 1986h; BLM, 1987c). If this recommendation is accepted, leasing, exploring and production of leasable minerals could occur subject to the Wyoming standard lease stipulations including stipulations limiting exploration and development for the purposes of protecting scenic, wildlife, watershed and soil resources. Wildlife habitat would be managed to support the population goals and numbers as stated in the Wyoming Game and Fish Department's Strategic Plan. Recreation opportunities would be designated as semi-primitive motorized with no visitor facilities or improvements. Livestock grazing would continue in its current management with the goal of improving the area's range condition.

Associated Projects. Between mileposts 130 and 140, the Bairoil/Dakota Pipeline would pass between Sweetwater Rocks WSA 122 and 123b. At its closest, the pipeline would be about 100 feet from each WSA. The pipeline would parallel the existing Frontier Pipeline through Beef Gap, which separates the two WSAs and would also be within five miles of Sweetwater Rocks WSA 120 and 123a.

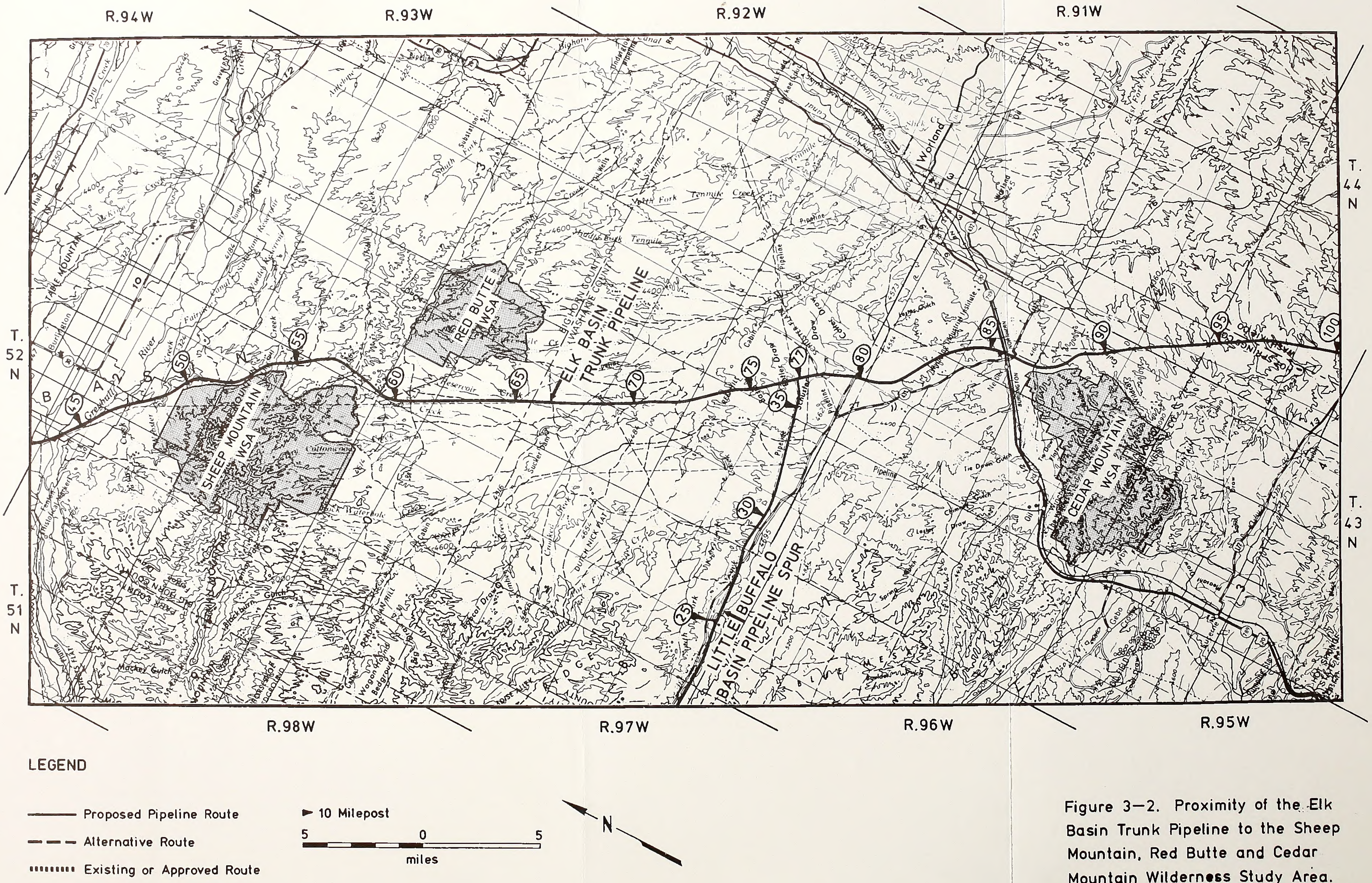


Figure 3—2. Proximity of the Elk Basin Trunk Pipeline to the Sheep Mountain, Red Butte and Cedar Mountain Wilderness Study Area.

3.12.4 Beaver Creek, Little Buffalo Basin and Salt Creek Projects

There are no wilderness resources within five miles of these projects.

3.12.5 Beaver Creek Alternative

The Beaver Creek Alternative alignment section would not be within five miles of any wilderness resource. This alignment would, however, affect all wilderness resources (Sheep Mountain, Cedar Mountain and Red Butte) affected by the Elk Basin Trunk Pipeline.

3.12.6 Frontier/Casper Alternative

There are no wilderness resources within five miles of this alternative alignment.

3.12.7 Exxon Alternative CO_2 Supply

The Riley Ridge wellfield is adjacent to the Lake Mountain WSA and the feed gas trunkline would be constructed about five miles east of this WSA. The pipeline would be built adjacent to the existing pipeline in this area (BLM, 1983c; BLM, 1987d).

3.12.8 No Action Alternative

The affected environment for wilderness resources for the No Action Alternative would be the same as those described for the Proposed Actions in Sections 3.12.2 through 3.12.4.

3.13 TRANSPORTATION NETWORKS

3.13.1 Introduction

Wyoming is typically rural and served by rural road systems. Three interstate highways are located in Wyoming: I-80 crossing the southern portion of the state from west to east; I-25 crossing from the southeast corner of the state to the north central border; and I-90 cutting through the northeastern portion of the state. Limited portions of the project areas and alternatives are served by I-25 or I-80. The majority is served by a network of paved U.S. and state highways, typically undivided two-lane highways. The U.S. and state systems are supplemented by secondary paved, gravel and dirt roads which are generally maintained by counties and various federal agencies (e.g., Bureau of Land Management and Bureau of Reclamation).

In addition to the public roads, an extensive system of roads or trails developed for existing energy developments is present in the vicinity of the proposed projects and alternatives. These roads supplement the local and federal systems.

The southern portion of Wyoming is crossed by main lines of the Union Pacific Railroad. The Burlington Northern Railroad serves the northern and north central portions of the state. Rail sidings to receive construction material could be used at Powell, Worland, Thermopolis, Riverton, Casper, Green River and Rock Springs.

3.13.2 Fontenelle Project

The proposed Fontenelle Plant would be constructed adjacent to Exxon's existing Shute Creek Plant approximately six miles south of the Fontenelle Dam in Sweetwater County. Access for both material and workers to the Fontenelle Plant would be via I-80 to State Highway 372 to the paved

Shute Creek Plant Road, from Rock Springs and Green River. Construction workers for the plant would be bused to the Fontenelle Plant and Raptor Field from Green River.

Development of the Raptor Field would require installation of a gas gathering system. Access to the westerly portion of the field would be via U.S. I-80 and State Highway 372. Access to the eastern portion of the field would be via I-80, State Highway 372, across the Green River on State Highway 28, then north. The bridge downstream of Fontenelle, locally called the Old Ford Bridge, is rated as unsafe, and is so marked. This bridge would not be used for construction equipment. Fontenelle Dam has recently undergone extensive reconstruction. The top of the dam contains a roadway, but the Bureau of Reclamation may deny or limit access to the roadway.

3.13.3 Elk Basin Project

The trunk pipeline would cross portions of Park, Big Horn, Washakie, Hot Springs, Fremont and Natrona counties. Within Park County, principal roads which would be used to transport material from a Burlington Northern Railroad siding at Powell are State Highways 114 and 295. Crossing into Big Horn County on State Highway 295, material would be transported for southern construction on State Highway 32, and U.S. 14/16/20. Portions of the proposed pipeline within Hot Springs and Washakie counties would be serviced by a siding in Worland, principally by way of U.S. 20. State Highway 172 would be used for access to portions of the pipeline in eastern Hot Springs County. U.S. 20/26 would serve as the primary route for delivery of material from a Burlington Northern Railroad siding in Casper, which would serve portions of the proposed right-of-way within Natrona and Fremont counties. The Arminto-Lost Cabin and Bridger Creek roads which parallel the proposed right-of-way for several miles (mileposts 125 - 155), would also provide access for workers and materials.

Construction workers for the Elk Basin Plant would live in the Powell area and be transported by bus to the construction site. Pipeline construction crews would likely live in Powell, Thermopolis, Worland, Riverton or Casper, and travel by individual or crew trucks to the construction site.

Associated Projects. Materials for construction of the Bairoil/Dakota Pipeline from mileposts 112 to 185 would be delivered via U.S. 287 from the Union Pacific siding in Rawlins, via State Highway 220 and U.S. 287 from Casper and/or via U.S. 20/26 from Casper. Pipeline workers are likely to live in the vicinity of either Casper or Rawlins and travel these same routes.

3.13.4 Beaver Creek Project

The Beaver Creek Project would be constructed in southeastern Fremont County. Construction crews for the Beaver Creek Plant would be bused from Riverton on State Highway 135. Material for pipeline construction would be delivered to the right-of-way on State Highway 135 and U.S. 287 from a Burlington Northern Railroad siding in Riverton.

3.13.5 Little Buffalo Basin Project

The Little Buffalo Basin Project would be constructed in southeastern Park County, northern Hot Springs County and northwestern Washakie County. Material for this project would be delivered to the plant site and pipeline right-of-way from Burlington Northern Railroad sidings in Worland via U.S. 20 and State Highway 431. Plant and field construction crews would be based in Worland and transported to the site by bus. Pipeline

personnel would primarily reside in Worland and Thermopolis.

3.13.6 Salt Creek Project

The Salt Creek Project would be constructed in the northeast portion of Natrona County. Access to the project area would be via I-25 from Casper. Material would be delivered from the Burlington Northern Railroad sidings in Casper to the Salt Creek Plant and pipeline. Plant construction crews would be housed in Casper and transported to the site via buses on I-25. Pipeline personnel would most likely reside in Casper.

Associated Projects. Materials for construction of the Bairoil/Dakota Pipeline from mileposts 185 to 221 would be delivered via U.S. 20/26, Interstate 25 and county roads 110, 114 and 125 from the Burlington Northern Railroad siding in Casper. Pipeline workers are likely to live in Casper and travel these same routes.

3.13.7 Beaver Creek Alternative

The Beaver Creek Alternative would be constructed in Fremont County and would cross the southeastern portion of the Wind River Indian Reservation. The majority of the pipeline construction crews would probably reside in Riverton, although workers may also come from Casper. Workers living in Riverton would travel State Highways 135 and 136, U.S. 26 and U.S. 20/26. Those coming from Casper would travel by way of U.S. 20/26. A variety of county roads would be used as well.

Material for pipeline construction would be delivered to the right-of-way on State Highways 136, U.S. 26 and U.S. 20/26 from a Burlington Northern Railroad siding in Riverton.

Other roads affected by this alternative would be the same as described for the Beaver Creek Trunk Pipeline and the Elk Basin Trunk Pipeline.

3.13.8 Frontier/Casper Alternative

The Frontier Casper Alternative includes two pipelines. The Frontier Access Section of the alternative would be constructed in Lincoln and Sweetwater counties. Access for both workers and material to the pipeline would be via I-80 to State Highway 372 from Rock Springs and Green River. County roads and existing access roads would also be used.

The Casper Section of the Frontier/Casper Alternative would be constructed in Natrona County, running roughly from Casper to Midwest. Access to the project area would be via I-25 and State Highway 259 from Casper. Material would be delivered from the Burlington Northern Railroad sidings in Casper to the pipeline. Personnel would most likely reside in Casper.

3.13.9 Exxon Alternative CO_2 Supply

The affected environment of the Phase II Shute Creek Plant would be the same as that described for the Fontenelle Plant. Construction of the feed gas trunkline would involve transport of workers and materials on U.S. 189. Wellfield activities would also use State Highways 235 and 350.

3.13.10 No Action lternative

For the No Action Alternative, the affected environment for transportation would be the same as previously described for the Proposed Actions in Section 3.13.2 through 3.13.6.

3.14 LAND USE PLANS, CONTROLS AND CONSTRAINTS

Aspects of federal and local land use planning that could constrain the proposed projects and alternatives generally consist of five types:

- o Designated avoidance areas;
- o Designated corridor areas;
- o Requirements to allow public review of actions and requiring permits;
- o Requirements to avoid unnecessary damage to the environment; and
- o Requirements to blend the project with the existing environment and to avoid conflicts with adjacent land uses.

Specific BLM and county management strategies, plans or regulations applicable to the proposed projects and alternatives are summarized in Table 1-1. See Figure 1-1 for the boundaries of resource areas and counties applicable to each Proposed Action and alternative.

3.15 HEALTH AND SAFETY

Health and safety concerns for the Proposed Actions and alternatives to the general public and to the construction and operation workforce are mainly from ruptures of CO_2 or sour gas pipelines and a subsequent gas release. Industrial and traffic-related accidents are of concern, although the accident rate is not expected to be of major concern.

CO_2 alone poses little or no health hazard either to oil field workers or the general public. However, if a CO_2 trunkline is ruptured, the high pressure could be hazardous due to flying rocks and broken pipe. The rapidly expanding CO_2 could also asphyxiate or freeze anyone adjacent to the rupture.

CO_2 is a respiratory stimulant as well as an asphyxiant. Inhalation of air containing 50,000 *ppm* will strongly stimulate respiration. Other observable symptoms of acute exposure include headache, rapid beating of the heart, sweating, shortness of breath, and dizziness. At concentrations of 70,000 to 100,000 ppm, unconsciousness will occur within a few minutes of exposure. In contrast, the normal concentration of CO_2 in the atmosphere is about 320 ppm.

The Federal Standard for permissible atmospheric CO_2 concentrations in the work place is 5,000 ppm (eight-hour exposure) (Occupational Safety and Health Act, 1987). The short-term exposure limit, which represents the maximal concentration to which workers can be exposed for up to 15 minutes continuously without suffering adverse health effects, is 30,000 ppm (American Conference of Governmental Industrial Hygienist, 1987-88). The *IDLH* (immediately dangerous to life or health) concentration, which represents the maximum level which one could escape within 30 minutes without an escape impairing symptom or any irreversible health effects, is 50,000 ppm (Sittig, 1981).

Historically, the presence of H_2S in oil and gas has constituted an occupational health and odor problem rather than a public health problem. Workers are the individuals who are routinely around facilities where accidental gas releases are apt to occur or where toxic levels of H_2S may build up in closed-in areas (BLM, 1983).

H_2S is a colorless gas that has a characteristic odor of rotten eggs. The specific gravity of the gas is 1.192 which is greater than air (1.00) and therefore the gas tends to settle in low areas. The gas forms an explosive mixture with air in the ranges of 4.3 to 45 percent, and has an ignition temperature of 500°F. In comparison, methane is combustible in the ranges of 5 to 15 percent and has an ignition temperature of 1,000°F.

An uncontrolled release of sour gas from a well or pipeline could cause serious occupational and public health

effects, depending on its magnitude, duration and location as well as the meteorology at the time of the release. The dose-dependent health effects of exposure to ambient concentrations of H_2S range from death to temporary odor annoyance. If the sour gas is ignited, H_2S will burn to form SO_2, which is less toxic. Both of these gases can have toxic effects on plants and animals.

CHAPTER 4
ENVIRONMENTAL CONSEQUENCES

4.1 INTRODUCTION

In order to evaluate the *impacts* of the *Proposed Actions* and alternatives on the physical environment, assumptions were made about project design and implementation. Where data are not available to evaluate a potential impact, a worst case situation analysis was used. It is assumed, for example, that pipeline construction would disturb a uniform 75-foot-wide *corridor*. While the entire construction right-of-way would be 75-feet wide, disturbance will actually be minimized in most areas by limiting grading and clearing to those places necessary to provide a safe working surface. Safety requires a cleared area for welding pipe (i.e., to avoid brush fires) and a level working surface for the ditching equipment. In steep terrain, however, sideslope cuts will require disturbance of more than 75 feet to create a level working surface. On federal land where more than 75 feet is required for construction, Amoco would need a *BLM* Temporary Use Permit.

Where the description of the project (Chapters 1 and 2) does not include specific techniques to be used for construction or *reclamation* in areas of various terrain, soils, *vegetation types*, wildlife *habitats*, etc., it is assumed that the "Provisions and Measures Designed to Reduce Environmental Impacts" (See Appendix 1) will be effectively implemented. These measures and site-specific techniques will be included in the Plans of Development which must be approved before the rights-of-way are granted. Therefore, estimates of erosion and the probability of reclamation success on disturbed areas are based on use of the Appendix 1 techniques. It is also assumed for this analysis that when operating on state or private land, techniques used to control impacts would be at least as effective as those implemented on federal land.

The analysis assumes that all approved reclamation measures will be "best practices" for the specific conditions of the sites and that appropriate personnel (either Amoco's or BLM's) will be available on-site to assure that impact control measures are properly implemented. Assumptions specific to a particular resource and significance criteria are outlined in the introduction to each resource.

4.2 SOCIOECONOMIC CONDITIONS

4.2.1 Introduction

For each of the projects evaluated in this DEIS, Amoco has committed to operating a busing program to direct *inmigrant* project workers to communities best suited to accommodate temporary growth. Amoco would also limit parking at the work sites.

In order to examine a worst case analysis of impacts on public facilities and services in these destination communities, it has been assumed that the total inmigrant *workforce* from each project would reside in the destination communities and counties. Recent monitoring of the Amoco Bairoil CO_2 Project indicated that over 90 percent of the total workforce rode the bus to and from the destination community of Rawlins. Therefore, it has been assumed that, on an annual basis, the number of inmigrant workers at each project who would not reside in the destination communities would be small. It is also assumed that these inmigrant workers would seek housing in a dispersed manner in communities surrounding the project area and would

not generate measurable socioeconomic impacts to non-destination communities. As a result, socioeconomic impacts for the Proposed Actions have been projected only for the destination communities for the busing programs.

The only exception to this approach involves the communities of Meeteetse, Midwest and Edgerton, three communities that have a tradition of housing workers involved in work activities at the Little Buffalo Basin (Meeteetse) and Salt Creek (Midwest and Edgerton) fields. Potential socioeconomic impacts to these towns associated with the Proposed Actions are also analyzed.

Each of these projects has a peak construction season which occurs in late spring, summer and early fall. During this peak season, a significant number of workers would be hired on a short-term basis. Immigrant workers hired for these peak seasons would seek temporary residence in motels, apartments and recreational vehicle parks.

Three of the destination communities for Amoco's busing programs (Green River, Powell and Worland) do not have capacity in temporary housing stock to accommodate this peak demand. It is anticipated that peak season workers from the Fontenelle Project would seek temporary housing in Rock Springs, which has a considerable number of vacant motel units, even during summer months. Similarly, peak season workers from both the Elk Basin and Little Buffalo Basin projects would seek temporary housing in Cody which also has a significant number of vacant motel units during summer months. Peak construction seasons for the Elk Basin and Little Buffalo Basin projects occur in different years.

It has also been assumed that a significant portion of the construction workforce for the plants, field facilities and pipelines would be drawn from local workers who would commute daily to the work site. During recent construction of the Amoco Bairoil CO_2 Project, 75 percent of the workforce were Wyoming residents. Over 60 percent of the workforce were hired locally. As a result of this experience and the continued high unemployment in the construction trades in Wyoming cities, a 60 percent local hire rate for construction workers has been assumed for this analysis. It is assumed that all drillers for the Fontenelle Project will be immigrants.

Given the temporary nature of the construction phase and the small operations workforce for each of these projects, it is likely that any indirect or non-basic response to the additional project-generated revenue in the destination communities would occur primarily in the retail and service sectors of the local economy. It has been assumed that 100 percent of additional non-basic workers would be hired locally.

It is not anticipated that *cumulative impacts* between the projects would occur. Construction sites and busing program destination cities for each project are spread across the state. In addition, project construction schedules do not overlap significantly. To date, no other projects have been identified in the vicinity of each project and during the construction period which could be expected to significantly decrease the present unemployment rates and thereby reduce the local hire ratio below 60 percent.

In general, as outlined in this section, socioeconomic impacts are expected to be beneficial. Construction of the projects would result in much-needed employment throughout the project areas. Sales and use tax revenues would be substantial for each impacted community, but would pale in comparison to projected increases in ad valorem taxes associated with production increases from each field.

4.2.2 Fontenelle Project

Project Workforce. Table 2-9 presents quarterly workforce projections for the Fontenelle Project. Processing plant and field facilities construction activities and drilling would commence in the second quarter of 1989; peak at an estimated 655 workers during the first quarter of 1990; and decrease to 50 workers by fourth quarter 1990. The operations workforce of eight total workers are projected to begin work in third quarter 1990.

Employment and Earnings. Table 4-1 presents impact employment and earnings data for Sweetwater County. As a result of the Fontenelle Project, total Sweetwater County employment and earnings would each increase by about 2 percent in both 1989 and 1990. Fontenelle Project operations employment would increase Sweetwater County total employment by nine workers; earnings would increase by approximately $187,000.

Population. Table 4-2 displays Sweetwater County and City of Green River average annual impact population projections from 1989 through 1991. The population increase generated by the Fontenelle Project would be less than 1 percent over baseline Sweetwater County population in all years, and about 2 percent over baseline City of Green River population in 1989 and 1990.

Housing. Table 4-3 contrasts peak quarter Fontenelle Project-generated housing demand with December 1987 housing availability in the City of Green River, the destination community for Amoco's proposed busing program. During the peak quarter, an estimated 97 temporary housing units beyond those available in the City of Green River in December 1987 would be needed. During peak periods it is anticipated that workers would be able to find temporary housing in Rock Springs, which had a total of 530 temporary housing units available in December 1987.

Local Government Facilities and Services. The less than 1 percent increase in Sweetwater County population generated by the Fontenelle Project would not cause demand for additional public facilities space or public services staff. The additional population would exacerbate the existing need for a county jail that meets federal standards. The 2 percent increase in the City of Green River population would not generate demand for additional public facilities space or public services staff.

The Fontenelle Project would generate an estimated 19 school age children in Sweetwater County School District #2 during the peak year of 1990, less than 1 percent of the district's fall 1987 enrollment. This number of students could be accommodated in the district's existing schools.

Local Government Revenues. The Fontenelle Project would generate approximately $539,000 in sales and use tax revenues to Sweetwater County and its municipalities. Of that total amount, Sweetwater County would receive approximately $100,000 (or less than 1 percent of total county FY 1986-87 revenues) and the City of Green River would receive approximately $165,000 (about 2 percent of total FY 1986-87 revenues).

Sweetwater County and Sweetwater County School District #2 would also receive ad valorem taxes from CO_2 production and plant and field facilities once the Fontenelle Project is completed. These revenues are currently not estimated.

4.2.3 Elk Basin Project

Project Workforce. Table 2-9 presents quarterly workforce projections for the Elk Basin Project. Construction activities would commence in the second quarter of 1989; peak at an estimated 762 workers (including 2 operations workers) during the third quarter of 1990; and decrease to 118 workers by fourth quarter 1990. The

Table 4-1. Impact Employment and Earnings Projections for Sweetwater County, Wyoming.

	1989	1990	1991
Employment			
Baseline (a)	20,149	20,190	20,185
With-Project (b)	20,536	20,575	20,194
Impact (c)	387	385	9
% Increase over baseline	1.9%	1.9%	0.0%
Earnings (86$) (d)			
Baseline (a)	469,337	470,292	470,176
With-Project (b)	477,220	478,107	470,363
Impact	7,883	7,815	187
% Increase over baseline	1.7%	1.7%	0.0%

a = Source: Wyoming Department of Administration and Fiscal Control, 1988.
b = Source: Planning Information Corporation, 1988.
c = Includes indirect workers induced by the project.
d = All dollars expressed in thousands.

Table 4-2. Average Annual Impact Population Projections; for the Fontenelle Project.

	1989	1990	1991
SWEETWATER COUNTY			
Population			
Baseline (a)	42,347	42,608	42,782
With-Project (b)	42,627	42,864	42,788
Impact	280	256	6
% Increase over baseline	0.7%	0.6%	0.0%
CITY OF GREEN RIVER			
Population			
Baseline (a)	13,417	13,480	13,541
With-Project (b)	13,697	13,736	13,547
Impact	280	256	6
% Increase over baseline	2.1%	1.9%	0.0%

a = Source: Wyoming Department of Administration and Fiscal Control, 1988.
b = Source: Planning Information Corporation, 1988.

Table 4-3. Destination Community Housing Availability Contrasted With Housing Demand for the Proposed Project. (a)

	Fontenelle Green River	Elk Basin Powell	Beaver Creek Riverton	Little Buffalo Basin Worland	Salt Creek Casper
DESTINATION COMMUNITY HOUSING AVAILABILITY					
Green River					
Standard Rental Housing Units	77	35	75	72	2006
Temporary Housing Units	90	32	125	15	1038
Total Housing Units Available	167	67	200	87	3044
HOUSING DEMAND					
Peak Quarter Inmigrant Employment	343	219(b)			
@ 1.3 Employees/Household	264				
Total Housing Unit Demand	264	168	163	145	169
Peak Quarter Temporary Housing Unit Demand Beyond Destination Community	97	101	0	58	0

a = Source: Planning Information Corporation.
b = Peak inmigrant employment includes all the plant and field workers and 1/3 of the pipeline workers. The remainder of the pipeline workers will live in different communities in Washakie and Natrona.

project would reach the operational level of eight workers by second quarter 1991.

Employment and Earnings. Table 4-4 presents impact employment and earnings data for Park County. As a result of the Elk Basin Project, total Park County employment would increase by about 4 percent in the peak construction year of 1990. Total Park County earnings would increase by approximately 5 percent during that year.

Population. Table 4-5 displays Park County and City of Powell average annual impact population projections from 1989 through 1992. The population increase generated by the Elk Basin Project would be 1 percent over baseline Park County population during the peak construction year of 1990, and about 4 percent over baseline City of Powell population during that year.

Housing. Table 4-3 contrasts peak quarter Elk Basin Project-generated housing demand with December 1987 housing availability in the City of Powell, the destination community for Amoco's busing program. During the peak quarter, an estimated 101 housing units beyond those available in Powell in December 1987 would be needed. During peak periods it is anticipated that workers would be able to find temporary housing in the City of Cody, which has an average of 355 temporary housing units available in summer.

Local Government Facilities and Services. The 1 percent increase in Park County population generated by the Elk Basin Project would not cause demand for additional public facilities space or public services staff. The additional population would exacerbate the existing overcrowding situation at the county jail. The 4 percent increase in the City of Powell population would not generate demand for additional public facilities space or public services staff.

The Elk Basin Project would generate an estimated 19 school age children in Park County School District #1 during the peak year of 1990, about 1 percent of the district's fall 1987 enrollment. This number of students could be accommodated in the district's existing schools.

Local Government Revenues. The Elk Basin Project would generate approximately $408,000 in sales and use tax revenues to Park County and its municipalities. Of that total amount, Park County would receive approximately $146,000 (or about 2 percent of total FY 1986-87 county revenues) and the City of Powell would receive approximately $100,000 (or about 2 percent of FY 1986-87 revenues).

Park County and Park County School District #1 would also receive ad valorem taxes from extended oil production and from the value of plant and field facilities once the Elk Basin Project is completed. These revenues are currently not estimated.

4.2.4 Beaver Creek Project

Project Workforce. Table 2-9 presents quarterly workforce projections for the Beaver Creek Project. Construction activities would commence in the second quarter of 1991, peak at an estimated 530 workers during the third quarter of 1992, and decrease to the operational level of 8 workers by third quarter 1993.

Employment and Earnings. Table 4-6 presents impact employment and earnings data for Fremont County. As a result of the Beaver Creek Project, total Fremont County employment would increase by about 2 percent in the peak construction year of 1992. Total Fremont County earnings would increase by approximately 3 percent during that year.

Population. Table 4-7 displays Fremont County and City of Riverton average annual impact population

Table 4-4. Impact Employment and Earnings Projections for Park County, Wyoming.

	1989	1990	1991	1992
Employment				
Baseline (a)	13,221	13,320	13,394	13,431
With-Project (b)	13,282	13,843	13,671	13,440
Impact (c)	61	523	277	9
% Increase over baseline	0.5%	3.9%	2.1%	0.1%
Earnings (86$) (d)				
Baseline (a)	193,976	195,429	196,514	197,057
With-Project (b)	195,176	205,883	201,956	197,236
Impact	1,200	10,454	5,442	179
% Increase over baseline	0.6%	5.3%	2.8%	0.1%

a = Source: Wyoming Department of Administration and Fiscal Control, 1988.
b = Source: Planning Information Corporation, 1988.
c = Includes indirect workers induced by the project.
d = All dollars expressed in thousands.

Table 4-5. Average Annual Impact Population Projections for the Elk Basin Project.

	1989	1990	1991	1992
PARK COUNTY				
Population				
Baseline (a)	23,407	23,575	23,740	23,897
With-Project (b)	23,445	23,816	23,911	23,902
Impact	38	241	171	5
% Increase over baseline	0.2%	1.0%	0.7%	0.0%
CITY OF POWELL				
Population				
Baseline (a)	6,044	6,087	6,130	6,170
With-Project (b)	6,082	6,328	6,301	6,175
Impact	38	241	171	5
% Increase over baseline	0.6%	4.0%	2.8%	0.1%

a - Source: Wyoming Department of Administration and Fiscal Control, 1988.
b - Source: Planning Information Corporation, 1988.

Table 4-6. Impact Employment and Earnings Projections for Fremont County, Wyoming.

	1991	1992	1993	1994
Employment				
Baseline (a)	16,387	16,405	16,422	16,438
With-Project (b)	16,433	16,782	16,460	16,447
Impact (c)	46	377	38	9
% Increase over baseline	0.3%	2.3%	0.2%	0.1%
Earnings (86$) (d)				
Baseline (a)	229,716	229,968	230,206	230,431
With-Project (b)	230,635	237,510	230,961	230,610
Impact	919	7,542	755	179
% Increase over baseline	0.4%	3.3%	0.3%	0.1%

a = Source: Wyoming Department of Administration and Fiscal Control, 1988.
b = Source: Planning Information Corporation, 1988.
c = Includes indirect workers induced by the project.
d = All dollars expressed in thousands.

Table 4-7. Average Annual Impact Population Projections for the Beaver Creek Project.

	1991	1992	1993	1994
FREMONT COUNTY				
Population				
Baseline (a)	37,707	38,099	38,341	38,533
With-Project (b)	37,736	38,316	38,364	38,538
Impact	29	217	23	5
% Increase over baseline	0.1%	0.6%	0.1%	0.0%
CITY OF RIVERTON				
Population				
Baseline (a)	10,172	10,278	10,343	10,395
With-Project (b)	10,201	10,495	10,366	10,400
Impact	29	217	23	5
% Increase over baseline	0.3%	2.1%	0.2%	0.0%

a = Source: Wyoming Department of Administration and Fiscal Control, 1988.
b = Source: Planning Information Corporation, 1988.

projections from 1991 through 1994. The population increase generated by the Beaver Creek Project would be less than 1 percent of baseline Fremont County population during all years and about 2 percent of City of Riverton population during the peak year of 1992.

Housing. Table 4-3 contrasts peak quarter Beaver Creek Project-generated housing demand with December 1987 housing availability in the City of Riverton, the destination community for Amoco's busing program. It is anticipated that the City of Riverton will easily be able to accommodate peak Beaver Creek Project-generated housing demand.

Local Government Facilities and Services. The less than 1 percent increase in Fremont County population generated by the Beaver Creek Project would not cause demand for additional public facilities space or public services staff. The 2 percent increase in City of Riverton population would not generate demand for additional public facilities space or public services staff.

The Beaver Creek Project would generate an estimated 15 school age children in Fremont School District #25 during the peak year of 1992, less than 1 percent of the district's fall 1987 enrollment. This number of students could be accommodated in the district's existing schools.

Local Government Revenues. The Beaver Creek Project would generate approximately $303,000 in sales and use tax revenues to Fremont County and its municipalities. Of that total amount, Fremont County would receive approximately $140,000 (about 1 percent of total county FY 1986-87 revenues) and the City of Riverton would receive approximately $81,000 (about 1 percent of total FY 1986-87 revenues).

Fremont County and Fremont County School District #1 would also receive ad valorem taxes from *incremental* oil production and from the value of plant and field facilities once the Beaver Creek Project is completed. These revenues are currently not estimated.

4.2.5 Little Buffalo Basin Project

Project Workforce. Table 2-9 presents quarterly workforce projections for the Little Buffalo Basin Project. Construction activities would commence in the second quarter of 1992; peak at an estimated 470 workers during the third quarter of 1993; and decrease to the operational level of 6 workers by third quarter 1994.

Employment and Earnings. Table 4-8 presents impact employment and earnings data for Washakie County. As a result of the Little Buffalo Basin Project, total Washakie County employment would increase by about 7 percent in the peak construction year of 1993. Total Washakie County earnings would increase by approximately 8 percent during that year.

Population. Table 4-9 displays Washakie County and City of Worland average annual impact population projections from 1992 through 1995. The population increase generated by the Little Buffalo Basin Project would be about 2 percent of baseline Washakie County population during the peak year of 1993 and about 3 percent of City of Worland population during that year.

Housing. Table 4-3 contrasts peak quarter Little Buffalo Basin Project-generated housing demand with December 1987 housing availability in the City of Worland, the destination community for Amoco's busing program. During the peak quarter, an estimated 58 housing units beyond those available in the City of Worland in December 1987 would be needed. During peak periods it is anticipated that workers would be able to find temporary housing in the cities of Cody or Thermopolis, which had a

Table 4-8. Impact Employment and Earnings Projection for Washakie County, Wyoming.

	1992	1993	1994	1995
Employment				
Baseline (a)	4,953	4,991	5,032	5,070
With-Project (b)	4,999	5,334	5,068	5,077
Impact (c)	46	343	36	7
% Increase over baseline	0.9%	6.9%	0.7%	0.1%
Earnings (86$) (d)				
Baseline (a)	83,634	84,276	84,968	85,610
With-Project (b)	84,562	91,168	85,687	85,749
Impact	928	6,892	719	139
% Increase over baseline	1.1%	8.2%	0.8%	0.2%

a = Source: Wyoming Department of Administration and Fiscal Control, 1988.
b = Source: Planning Information Corporation, 1988.
c = Includes indirect workers induced by the project.
d = All dollars expressed in thousands.

Table 4-9. Average Annual Impact Population Projections for the Little Buffalo Basin Project.

	1992	1993	1994	1995
WASHAKIE COUNTY				
Population				
Baseline (a)	10,410	10,522	10,631	10,738
With-Project (b)	10,439	10,724	10,653	10,742
Impact	29	202	22	4
% Increase over baseline	0.3%	1.9%	0.2%	0.0%
CITY OF WORLAND				
Population				
Baseline (a)	6,836	6,910	6,981	7,052
With-Project (b)	6,865	7,112	7,003	7,056
Impact	29	202	22	4
% Increase over baseline	0.4%	2.9%	0.3%	0.1%

a - Source: Wyoming Department of Administration and Fiscal Control, 1988.
b - Source: Planning Information Corporation, 1988.

total of 397 temporary housing units available in December 1987.

Local Government Facilities and Services. The 2 percent increase in Washakie County population generated by the Little Buffalo Basin Project would not cause demand for additional public facilities space or public services staff. The 3 percent increase in City of Worland population would not generate demand for additional public facilities space or public services staff.

The Little Buffalo Basin Project would generate an estimated 15 school age children to Washakie County School District #1 during the peak year of 1992, less than 1 percent of the district's fall 1987 enrollment. This number of students could be accommodated in the district's existing schools.

Local Government Revenues. The Little Buffalo Basin Project would generate approximately $16,000 in sales and use tax revenues to Washakie County and its municipalities. Of that total amount, Washakie County would receive approximately $4,500 (less than 1 percent of total county FY 1986-87 revenues) and the City of Worland would receive approximately $10,500 (less than 1 percent of total FY 1986-87 revenues).

Washakie County and Washakie County School District #1 would also receive a small amount of ad valorem tax revenues from the value of the pipeline located in the county. These revenues are currently not estimated.

Town of Meeteetse

In order to display a "worst case" scenario, the total population, employment, housing and local government impacts of the Little Buffalo Basin Project have been projected for Washakie County and the City of Worland, the destination community for Amoco's busing program. However, it is possible that the Park County town of Meeteetse may receive some population impacts from the Little Buffalo Basin Project because of the town's proximity to the work site. The temporary housing units in Meeteetse are frequently occupied, depending on project activities at the Little Buffalo Basin Field. It is anticipated that the Little Buffalo Basin Project would result in a continuation of that pattern.
It is also possible that a portion of the 25 standard housing units that are currently for rent or sale would be occupied by project workers. If all 25 were occupied, it would result in an influx of an estimated 45 people (based on average household size from the recent Amoco Bairoil CO_2 Project). This would be less than 10 percent of estimated 1988 Meeteetse population (479) and the town's recent (1983) peak of 545 people. This "worst case" impact population would not cause demand for additional public facilities space or services staff in the town of Meeteetse or Park County School District #16. Meeteetse would receive an estimated $5,000 in sales tax revenues from construction of the Little Buffalo Basin Project, which is about 2 percent of total FY 1986-87 town revenues.

4.2.6 Salt Creek Project

Project Workforce. Table 2-9 presents quarterly workforce projections for the Salt Creek Project. Construction activities would commence in the fourth quarter of 1993; peak at an estimated 550 workers during the second quarter of 1994; and decrease to the operational level of 6 workers by first quarter 1998.

Employment and Earnings. Table 4-10 presents impact employment and earnings data for Natrona County. As a result of the Salt Creek Project, total Natrona County employment would increase by about 1 percent in the peak construction year of 1994. Total Natrona County earnings would

Table 4-10. Impact Employment and Earnings Projections for Natrona County, Wyoming.

	1993	1994	1995	1996	1997	1998
Employment						
Baseline (a)	36,370	36,558	36,743	36,925	37,104	37,282
With-Project (b)	36,443	37,009	36,953	37,188	37,317	37,289
Impact (c)	73	451	210	263	213	7
% Increase over baseline	0.2%	1.2%	0.6%	0.7%	0.6%	0.0%
Earnings (86$) (d)						
Baseline (a)	648,322	651,673	654,971	658,215	661,406	664,579
With-Project (b)	649,800	660,856	659,247	663,555	665,743	664,721
Impact	1,478	9,183	4,276	5,340	4,337	142
% Increase over baseline	0.2%	1.4%	0.7%	0.8%	0.7%	0.0%

a = Source: Wyoming Department of Administration and Fiscal Control, 1988.
b = Source: Planning Information Corporation, 1988.
c = Includes indirect workers induced by the project.
d = All dollars expressed in thousands.

Table 4-11. Average Annual Impact Population Projections for the Salt Creek Project.

	1993	1994	1995	1996	1997	1998
NATRONA COUNTY						
Population						
Baseline (a)	67,995	68,440	68,863	69,284	69,687	70,087
With-Project (b)	68,040	68,712	68,993	69,447	69,819	70,091
Impact	45	272	130	163	132	4
% Increase over baseline	0.1%	0.4%	0.2%	0.2%	0.2%	0.0%
CITY OF CASPER						
Population						
Baseline (a)	50,440	51,721	53,034	54,378	55,755	57,167
With-Project (b)	50,485	51,993	53,164	54,541	55,887	57,171
Impact	45	272	130	163	132	4
% Increase over baseline	0.1%	0.5%	0.2%	0.3%	0.2%	0.0%

a = Source: Wyoming Department of Administration and Fiscal Control, 1988.
b = Source: Planning Information Corporation, 1988.

also increase by approximately 1 percent during that year.

Population. Table 4-11 displays Natrona County and City of Casper average annual impact population projections from 1993 through 1998. The population increase generated by the Salt Creek Project would be less than 1 percent of both baseline Natrona County and City of Casper population during all years.

Housing. Table 4-3 contrasts peak quarter Salt Creek Project-generated housing demand with December 1987 housing availability in the City of Casper, the destination community for Amoco's busing program. It is anticipated that the City of Casper will be able to accommodate the peak project-generated housing demand.

Local Government Facilities and Services. The less than 1 percent increase in Natrona County population generated by the Salt Creek Project would not cause demand for additional public facilities space or public services staff. The less than 1 percent increase in City of Casper population would not generate demand for additional public facilities space or public services staff.

The Salt Creek Project would generate an estimated 21 school age children to Natrona County School District #1 during the peak year of 1994, less than 1 percent of the district's fall 1987 enrollment. This number of students could be accommodated in the district's existing schools.

Local Government Revenues. The Salt Creek Project would generate approximately $2,200,000 in sales and use tax revenues to Natrona County and its municipalities. Of that total amount, Natrona County would receive approximately $400,000 (about 3 percent of total county FY 1986-87 revenues) and the City of Casper would receive approximately $1,600,000 (5 percent of total FY 1986-87 revenues).

Natrona County and Natrona County School District #1 would also receive ad valorem tax revenues from extended oil production and from the value of plant and field facilities once the Salt Creek Project is completed. These revenues are currently not estimated.

Towns of Midwest and Edgerton

Although it is anticipated that the majority of the Salt Creek Project workforce will reside in the City of Casper, the destination community for Amoco's busing program, it is possible that some workers will locate in existing vacant housing in the Towns of Midwest and Edgerton, which are relatively near the Salt Creek Field.

Midwest had an estimated 5 standard housing units for rent in December 1987; Edgerton had an estimated 16 standard units for rent at that time. If all of these units were to fill with project employees and their families, the resultant population (9 in Midwest, 29 in Edgerton) would still be below 10 percent of 1988 population in both towns. This additional population would not generate demand for additional public facilities space or public service staff in either town or Natrona County School District #1.

The construction of the Salt Creek Project would generate $20,000 (5 percent of total FY 1986-87 revenues) in sales and in tax revenues to the Town of Midwest and $16,000 (about 6 percent of total FY 1986-87 revenues) to the Town of Edgerton. Midwest would receive additional production-related revenues.

4.2.7 Beaver Creek Alternative

Because of its location and length, construction of the Beaver Creek Alternative Alignment would result in virtually the same impacts as the

Beaver Creek Project pipeline construction.

4.2.8 Frontier/Casper Alternative

Construction of the Frontier/Casper Alternative would result in virtually the same impacts as the Fontenelle and Salt Creek Projects.

4.2.9 Exxon Alternative CO_2 Supply

The projected socioeconomic impacts of Phase II of the Exxon LaBarge Project are described in detail in the Wyoming Industrial Siting Application for Phase II (Exxon, 1985). In that application, Exxon projected a peak workforce of 5,251 workers during the third quarter of 1985 for Phase I (amended) and a peak of 2,425 workers (third quarter 1987) for Phase II construction. Exxon's monitored workforce for Phase I (amended) was 6,421 (fourth quarter 1985) or 18 percent higher than the projections, primarily due to unanticipated materials scheduling and weather problems. The peak workforce projections contained in the Phase II application are the most recent that exist for Phase II construction.

The LaBarge Project was projected to generate a peak average annual inmigrant population of 8,512 (1985) during Phase I and 5,397 (1987) during Phase II.

4.2.10 No Action Alternative

Implementation of the No Action Alternative would not result in any socioeconomic impacts. However, implementation of this alternative would result in a significant loss of potential revenues and employment in the project areas.

4.3 SOILS AND VEGETATION

4.3.1 Introduction

Impacts to soils and vegetation resources would primarily result from land disturbing activities including construction of facilities. Since existing roads are considered adequate for access to the right-of-way, disturbance would be confined to the plant sites, rights-of-way, staging areas for road and river crossings, additional areas needed for construction in steep terrain and wellfield-related activities.

Most of these impacts would be short-term since all disturbed areas not needed for operations would be reclaimed within a year of construction. Most reclamation would be completed within a few months of disturbance. With effective use of standard BLM impact control and *mitigation* measures, understory vegetation in sites without special problems is expected to return to near-preconstruction conditions within five years after construction. Problem areas may require replanting and/or use of special revegetation techniques if revegetation does not respond in one to two growing seasons. In areas of limited precipitation (less than 10 inches) and where there are shallow soil and/or low *permeability* soil problems identified in Section 3.3, reclamation techniques which enhance permeability and conserved moisture would increase the potential for successful revegetation. Impacts to overstory vegetation would be more long-term taking several years to become reestablished, e.g., 10 to 20 years for sagebrush types, 20 to 30 years for desert shrub vegetation and 50 to 75 years for coniferous woodland tree species (BLM, 1985a).

Table 4-12 illustrates the importance of erosion control techniques to minimize impacts from construction. It compares soil lost on a given area 1) without construction, 2) when disturbance is reclaimed in the fall

Table 4-12. Universal Soil Loss Equation Sample Calculations for Disturbed and Undisturbed Areas. (a)

Description	R (b)	C (c) 1	2	3	4	5	K	LS	Tons Per Acre of Erosion: Without Construction (Per Year)	Seeded in Fall (d): Year 1 With Mulch	Year 1 W/O Mulch	Year 2	Reseeding Delayed (e): Year 1	Year 2	2-Year Erosion Totals (Tons Per Acre): Seeding in Fall With Mulch	Seeding in Fall W/O Mulch	Reseeding Delayed No Mulch
BADLANDS NEAR SHEEP MOUNTAIN																	
Standard values	20	1.20	0.64	0.54	0.04												
Soil BH471; 400' @ 20% slope; 25% shrub cover, 0% grass						0.36	0.37	8.0	21.3	12.3	52.1	32.1	56.1	67.1	44.5	84.3	123.2
Soil BH471; 40' @ 50% slope; 25% shrub cover, 0% grass						0.36	0.37	11.0	29.3	16.9	71.7	44.2	77.2	92.2	61.1	115.9	169.4
BEAVER DIVIDE																	
Standard values	20	1.20	0.64	0.54	0.04												
Soil F277; 650' @ 15% slope; 25% shrub cover, 20% grass						0.17	0.37	6.5	8.2	8.1	33.2	26.1	36.4	54.5	34.1	59.3	90.9
Soil F277; 650' @ 30% slope; 25% shrub cover, 20% grass						0.17	0.37	20.0	25.2	24.8	102.1	80.2	112.1	167.7	105.1	182.3	279.7

a - The Universal Soil Loss Equation is A = R * K * LS * C, where
A = soil loss in tons/acre
R = rainfall factor
K = erodibility factor of surface horizon
LS = length-slope factor
C = cover and erosion control practices factor
Source: Barfield et al., 1987.

b - R is proportioned by geographic area and assumes disturbance in year 1 on 6/1, seeding on 10/1 and good germination on 4/1 of year 2; if seeding is delayed, it is delayed until 10/1 of year 2.

c - C1 = bare, bulldozer compacted
C2 = seeded but before germination
C3 = good germination after reseeding
C4 = mulched with wood fiber or asphalt emulsion immediately after disturbance
C5 = native vegetation.

d - Disturbed areas reseeded in fall of the year disturbed.

e - Disturbed areas not reseeded until fall of the year following construction.

of the year of disturbance, and 3) when reclamation is postponed until fall of the following year. It is evident from the comparison that disturbance accelerates erosion and that steep slopes are particularly susceptible to increased soil loss. The table also illustrates the benefits of erosion control materials applied in the interim between disturbance and reseeding.

The Plans of Development would include a weed control program that would control poisonous plants, noxious weeds and any major problems with annual weeds. This program must be in compliance with federal, state and local regulations or acceptable to the applicable landowner. Based on observation of existing pipeline corridors adjacent to the proposed pipelines, weeds, particularly halogeton, may be a problem in some areas.

While there are no *threatened*, endangered or proposed plant species in the project areas, the projects may affect candidate species. Since plant surveys have not been conducted for the pipeline rights-of-way, sufficient information is not available to evaluate potential impacts of pipeline construction on these species. Before final authorization of any of the projects, a survey, based on available location and habitat data, would be conducted for these species. If a conflict between the plants and a construction area is identified, appropriate mitigation measures would be developed to assure that project construction would not contribute to the need to list any of these candidate species as threatened or endangered. See Section 3.3 for a discussion of plant species in each project area.

Some adverse impacts will occur at all projects during construction and operation. The significance of the impact of a project on the existing system would, however, depend on both baseline conditions and impact control and mitigation measures implemented at each site. Effects specific to a particular project are discussed in each project section. The direct, adverse effects which would, to some degree, accompany all construction, are summarized in Table 4-13 along with general measures which would be used to minimize impacts.

Site-specific mitigation measures to reduce erosion and to improve potential for revegetation success would be addressed in the PODs. Table 4-14 provides a comparison of the proposed projects and alternatives in terms of major factors contributing to erosion.

Table 4-15 indicates the acreage of each vegetation type which would be disturbed during construction of the projects. Acreage of vegetation disturbed was based on an estimation of the miles of each vegetation type which would be crossed by the proposed pipelines. Since 0.1 mile (530 feet) was the smallest increment assigned to any type of vegetation crossed, the disturbance of narrow bands of vegetation, i.e., particularly ephemeral riparian areas, has been exaggerated. Pipeline disturbance of the most important riparian habitats are discussed in each project section.

Acreage which would be disturbed through replacement of producing and injection pipelines within the project fields is also indicated in Table 4-15. This estimate assumes that all existing production and injection pipelines in all fields would require replacement. Since the location of pipelines that would be replaced is not currently known, the impact on each vegetation type within the wellfields cannot be estimated at this time.

4.3.2 Fontenelle Project

Sagebrush/grassland, the most common vegetation type in the vicinity, poses no particular problem for reclamation. Much of the desert shrub

Table 4-13. Potential Adverse Impacts of Project Construction on Soils and Vegetation and Measures Planned to Minimize Impacts.

Adverse Impacts	Mitigation
Compaction of soil on the right-of-way by construction equipment and construction workers' vehicles	Minimize travel on the right-of-way; rip compacted areas prior to revegetation; construct barriers to limit use after construction; restrict right-of-way travel to essential maintenance
Alteration of the soil profile in all excavation areas	Segregate topsoil and subsoil where adequate topsoil exists
Potential reduction in soil stability in steep slope areas	Implement steep slope erosion control measures; closely monitor effectiveness and implement remedial action when necessary
Accelerated wind and water erosion on unsurfaced access roads during wet weather and in construction areas until revegetation or erosion control measures are implemented	Limit construction in wet weather; implement erosion control measures without delay
Loss of vegetation productivity for the period of construction and until regrowth and plantings restore productivity	Limit grading to areas required for safe work site; maintain clean work site (e.g., proper disposal of waste oil, scrap pipe, etc.); use "best practices" for revegetation;
Increased instability of stream banks with removal of riparian vegetation	Leave stream buffer zone for river crossings; use mechanical bank stabilization where appropriate (riprap, erosion blanket, etc); prohibit blading of the right-of-way in riparian zones; implement special practices for riparian area revegetation
Damage to vegetation in areas where steep slope construction requires side cuts and fills	Minimize cut and fill areas
Off-site loss of vegetation productivity due to increased off-road vehicle use in the construction area	Limit construction worker travel to right-of-way; discourage illegal ORV use of workers
Invasion of weeds onto disturbed right-of-way soils and their potential introduction into other relatively weed-free areas	Implement weed control program where necessary

Table 4-14. Major Factors Contributing to Soil Erosion on Project Pipelines. (a)

Project	Pipeline Construction Disturbance (acres)	Sensitive Soils Traversed (miles)	Steep Slopes Traversed (miles)	Relative Order of Potential Soil Loss (b)
FONTENELLE	218	4	0.1	9
EXXON ALTERNATIVE CO2 SUPPLY	346	--	--	8
ELK BASIN	1637	248	12	3
Associated Projects	665	8	8	
BEAVER CREEK	404	42	3	6
Total of Elk Basin and Beaver Creek	2706	198	20	1
BEAVER CREEK ALTERNATIVE	2109	21	202	2
LITTLE BUFFALO BASIN	326	23	3	7
SALT CREEK	85	8	1	10
Associated Projects	328	7	7	
Total Salt Creek Pipeline	413	15	8	5
FRONTIER/CASPER ALTERNATIVE	578	54	5	4

a = Order of soil loss is in decreasing order; analysis assumed:
(1) the greater the area of disturbance the greater the soil loss from erosion
(2) soil erosional losses would be correlated with the amount of sensitive soils traversed and
(3) soil losses would also be positively correlated to the miles of steep slopes traversed

b = Table is for comparison purposes only. It does not consider site specific mitigation measures which will be addressed in the Plan of Development and implemented to reduce impacts.

Table 4-15. Acreage of Vegetation to be Disturbed during Pipeline and Plant Construction and Replacement of Wellfield Pipelines. (a)

Vegetation Type	Fontenelle Short Term	Fontenelle Long Term	Exxon Alternative CO2 Supply Short Term	Exxon Alternative CO2 Supply Long Term	Elk Basin Short Term	Elk Basin Long Term	Beaver Creek Short Term	Beaver Creek Long Term	Little Buffalo Short Term	Little Buffalo Long Term	Salt Creek Short Term	Salt Creek Long Term	Beaver Creek Alternative Short Term	Beaver Creek Alternative Long Term	Frontier/Casper Alternative Short Term	Frontier/Casper Alternative Long Term
PLANTS AND PIPELINES																
Sagebrush/Grassland	281			38	849	41	263	40	163	40	18	0	419	0	316	
Desert Shrub	12	1		20	482	0			87	0	36	40			79	
Grassland	14	26		59	32		64				17		26		125	
Coniferous Woodland							4		12							
Mixed Shrub					49	0	18						11			
Riparian	17	32		78	98		56		36		14		49		51	
Cropland					89	0			26						5	
Barren/Badlands					25				1							
Disturbed						(b)		(b)		(b)		(b)			2	
Undetermined			346		15			0		0		0				
Totals	323	58	346	195	1637	41	404	41	326	41	85	40	505	0	578	
Associated Project Pipeline					665	0					328	0				
WELLFIELD PIPELINE																
Undetermined	263	192	737	376	683		228		819		1775					

a = Source: Table derived from tables and maps in the Soils, Vegetation and Agriculture Technical Report.

b = Amount of disturbed area to be redisturbed is unknown.

community, however, occupies shallow soil with low permeability. Coupled with low precipitation, these communities would be more difficult to reestablish.

About 218 acres would be disturbed during construction of the gas gathering system. The gentle terrain of most of the route would limit accelerated erosion. However, special attention to erosion control in the area of Slate Creek would be necessary to prevent accelerated sediment contribution to the Green River. Sediment barriers may be appropriate in the creek, depending on stream flow at the time of construction.

The majority of the 17 acres of riparian vegetation which would be disturbed during construction of the gas gathering system is associated with ephemeral drainages, although about 4.3 acres would be disturbed at the Green River crossing. About 0.2 acres of this disturbance would be for block valves to be used for the life of the project. The proposed crossing location was chosen because other utility lines have used the same location, i.e., the crossing has already been disturbed. Special erosion control and revegetation efforts at the river crossing would be necessary to minimize impacts to the river and its banks.

Soils of the plant site are deep but fine textured with both permeability and salinity problems which would require special attention for revegetation. Most of the plant site supports a greasewood community (a sub-type of the riparian vegetation type), which accounts for the remainder of long-term riparian loss. Loss of this acreage would not be a significant loss of riparian habitat.

Amoco has agreed to drill all wells on relatively gentle upland slopes rather than on steep side slopes where possible. This would minimize erosion and facilitate revegetation of the sagebrush/grassland vegetation. An estimated 263 acres would be disturbed for well pad and production pipelines that would be reclaimed after construction. An additional 192 acres of roads and well pad would remain in use for the life of the project.

The Fontenelle CO_2 Supply Project should not adversely affect any rare plant species. Only one taxon of concern (*Astragalus jejunus ssp. nov.*) is known from the area. Because the location of the subspecies of interest is in question and the species is relatively widespread, no site-specific studies are recommended for the area.

4.3.3 Elk Basin Project

About 1,637 acres would be disturbed during construction of the Elk Basin Trunk Pipeline. Most of this disturbance is adjacent to existing pipeline corridors. Much of the route is relatively level or gently rolling but there are three major areas of steep or dissected terrain that would be crossed: the vicinity of Sheep Mountain, Zimmerman Butte area and Kirby Creek area near Lysite Mountain. Special attention to erosion control in these areas is necessary to limit erosion and to increase the likelihood of revegetation success. Sagebrush/grassland constitutes about 65 percent of this short-term disturbance. Desert shrub vegetation accounts for another 30 percent.

About 98 acres of riparian vegetation would be disturbed in the short-term. Most of this disturbance would be at ephemeral drainage crossings. More diverse riparian zones would be disturbed at the *perennial stream* crossings and three river crossings, although the river crossing areas are primarily cropland. All proposed river crossing locations were chosen because they are adjacent to existing pipeline corridors and have been previously disturbed by pipeline construction.

With appropriate attention to limiting impacts (e.g., maintaining a buffer zone between the river banks and staging areas) and to revegetation, the corridor disturbance through the riparian zone can be reclaimed. With the supplemental water associated with the zone, revegetation success is more likely in the riparian zone than in the adjacent uplands.

About 40 acres of sagebrush/grassland, the most common type of the area, would be disturbed at the plant site for the life of the project (Table 4-15). An additional 683 acres of short-term disturbance is estimated for replacement of wellfield pipelines. A long-term decrease in riparian vegetation may occur in Silver Tip Creek from a decrease in surface discharge of produced water.

Associated Projects. Construction of the Bairoil/Dakota Pipeline (mileposts 112 - 185) would result in short-term disturbance of approximately 665 acres, primarily sagebrush/grassland and desert shrub. This disturbance would be adjacent to an existing pipeline corridor to the vicinity of milepost 140. Steep slope construction on Green Mountain (mileposts 112 - 120) could be avoided by constructing the Crooks Gap Option rather than the proposed route (see Map 10).

The extent of riparian vegetation loss for this section of the Bairoil/Dakota Project was not calculated (BLM, 1985a), but it can be assumed that the loss would be most important along the seven perennial streams. Three of these streams, Dry Creek, Poison Spider and Middle Fork of Casper creeks, are not crossed at existing pipeline disturbances.

4.3.4 Beaver Creek Project

About 404 acres would be disturbed in construction of the Beaver Creek Trunk Pipeline (Table 4-15). Most of this disturbance would occur in existing pipeline corridors and would be a short-term impact. The most severe erosion control and reclamation problem would be in the approximately 1.5 miles of steep terrain crossing Beaver Divide. The area has already been disturbed during development of the Big Sand Draw Oil Field and by numerous pipeline corridors. Since this is also a landslide area, special erosion and landslide control measures would be needed to assure site stability and reclamation success.

About 56 acres of riparian vegetation would be disturbed, mostly in ephemeral drainage crossings. More diverse riparian zones would be disturbed on the Sweetwater River, Ice Slough and Crooks Creek. One area of riparian vegetation near the Sweetwater River and one near Crooks Creek could be avoided if blading in the area is strictly limited. About 40 acres of sagebrush/grassland would be disturbed at the plant site for the life of the project (Table 4-15). An additional 228 acres of short-term disturbance is estimated for replacement of wellfield pipelines.

4.3.5 Little Buffalo Basin Project

About 326 acres would be disturbed during construction of the Little Buffalo Basin Spur Pipeline. The proposed route, which follows an abandoned pipeline corridor and State Highway 431 along Gooseberry Creek, avoids most of the steep, badlands terrain in the area. The steep areas that would be traversed are primarily at the entrance to Little Buffalo Basin and in the vicinity of Hillberry Rim, areas which have been traversed by other pipelines and which would be difficult to avoid. Because of the proximity of these steep areas to Gooseberry and Buffalo creeks, special erosion control measures would be necessary to limit accelerated erosion and prevent

accelerated sediment contribution to the agricultural areas.

Sagebrush/grassland constitutes about 50 percent of this short-term disturbance and about 27 percent would be in the desert shrub type. At least 12 acres of coniferous woodland would be disturbed. Since most of these woodlands are in steep terrain where side hill cuts may be necessary, additional disturbance is likely to be needed to provide a safe working surface. This additional acreage would be addressed under a Temporary Use Permit.

About 36 acres of riparian vegetation would be disturbed in the short-term. More than half of this disturbance would be in Little Buffalo Creek, within the Little Buffalo Basin Field boundary, and along Gooseberry Creek. Disturbance of riparian vegetation along Little Buffalo Creek could be reduced by final alignment of the right-of-way adjacent to rather than in the riparian zone. The remainder of riparian vegetation disturbance would be associated with ephemeral drainages. Disturbance in Little Buffalo Creek would be primarily in a mixed herbaceous/shrub community. Disturbance in most of the Gooseberry Creek drainage would be on terraces of greasewood, except in locations where the pipeline would cross the creek. Although the Killifish Exclosure would be crossed, the disturbance would occur adjacent to the highway right-of-way and above the zone of riparian vegetation.

About 40 acres of sagebrush/grassland would be disturbed for the life of the project (Table 4-15). An additional 819 acres of short-term disturbance is estimated for replacement of wellfield pipelines.

4.3.6 Salt Creek Project

About 85 acres would be disturbed during construction of the Salt Creek Spur Pipeline. While large steep slope areas are limited in the Salt Creek area, steep ephemeral drainages are common. Special attention to erosion control should be considered to limit accelerated erosion. This is particularly important for the Salt Creek area in order to meet the goals for the sensitive watershed designation.

Desert shrub, the most common type in the vicinity, constitutes about 43 percent of the disturbance. While the spur pipeline would not cross any perennial creeks, it would cross Dugout Creek, a wide draw. The area should not be crossed when the soils are saturated.

Plant construction would disturb about 40 acres of desert shrub vegetation for the life of the project. An additional 1,775 acres of short-term disturbance is estimated for replacement of wellfield pipelines. This disturbance would occur over a period of about four years.

Associated Projects. Construction of the Bairoil/Dakota Pipeline (mileposts 185 - 221) would result in short-term disturbance of approximately 328 acres, primarily sagebrush/grassland, desert shrub and grassland. All riparian disturbance would be in ephemeral drainages.

4.3.7 Beaver Creek Alternative

About 505 acres would be disturbed during construction of the Beaver Creek Alternative alignment section. The most severe erosion control and reclamation problem would be in the approximately one mile of steep terrain traversing the bluff above Badwater Creek. While the route follows an existing Montana-Dakota Utilities Pipeline, the terrain is steep and the best construction terrain is already occupied by pipe and power lines. The potential for controlling erosion may be enhanced by diverging from the pipeline corridor for about two miles in order to cross the bluff about one mile to the west. If a right-of-way is granted

for this alternative, the *Plan of Development* should address this area through either specific construction and reclamation methods or rerouting as described above.

Table 4-15 provides estimated acreage of each vegetation type which would be disturbed by construction. Essentially all of the acreage would be short-term disturbance since the only permanent structure in this area would be a block valve.

About 49 acres of riparian vegetation will be disturbed in the short-term. Most of this disturbance will be in ephemeral drainage crossings. More diverse riparian zones will be disturbed on Badwater, Poison and Bridger creeks. The south option for joining the main Elk Basin route would avoid disturbance of almost two miles of riparian vegetation along Bridger Creek, but would require about 0.7 miles more steep terrain construction.

The majority of riparian vegetation disturbance in the Bridger Creek area could be avoided by diverging from the existing pipeline corridor at about milepost 52 and following the Bridger Creek Road north to where it intersects the proposed Elk Basin Trunk Pipeline route at about milepost 128. This realignment would eliminate disturbance of riparian vegetation at four crossings of Bridger Creek.

In total, the Beaver Creek Alternative, from milepost 112 of the Bairoil/Dakota Pipeline to the Elk Basin Field, would disturb 404 acres along the Beaver Creek Trunk Pipeline, 505 acres on the Beaver Creek Alternative Section and about 1,200 acres of the Elk Basin Trunk Pipeline for a total of about 2,109 acres of short-term disturbance. Construction of this pipeline alternative would function to supply CO_2 to both the Elk Basin and Beaver Creek fields, which individually would require disturbance of 1,637 and 404 acres, respectively. This alternative would not require disturbance of the 665 acres associated with the Bairoil/Dakota Pipeline (mileposts 112 - 185).

4.3.8 Frontier/Casper Alternative

Table 4-15 provides estimated acreage of each vegetation type which would be disturbed during construction. Essentially all of the acreage disturbed by the alternative pipeline alignment would be short-term disturbance since the only permanent structures in this area would be the origin station and a block valve. About 218 acres would be disturbed along the Frontier Access Section. With less than 9 inches of average annual precipitation, revegetation may be difficult. About 360 acres would be disturbed along the Casper Section, but with precipitation averaging over 12 inches, revegetation should not pose a problem.
No significant areas of riparian vegetation would be disturbed in the Frontier Access Section. The main riparian areas in the Casper Section are Teapot Creek and Casper Creek. The proposed alignment along Teapot Creek would disturb the riparian zone for more than a mile. This disturbance must be avoided by adjusting the alignment to follow another pipeline route about one mile to the east. Disturbance of Casper Creek riparian vegetation should also be minimized by moving the creek crossing such that a railroad crossing bore pit (milepost 38.8) is not situated in the riparian zone. Minimizing impacts on both Teapot and Casper creeks would be addressed in detail in the POD.

4.3.9 Exxon Alternative CO_2 Supply

Construction of the Phase II Shute Creek Plant will disturb an estimated 195 acres for the life of the project. The plant site soils are simi-

lar to the Fontenelle Plant site soils, being deep but fine textured with both permeability and salinity problems which would require special attention for revegetation. About 78 acres (40 percent) of the plant site supports a greasewood community (a sub-type of the riparian vegetation type). Loss of this acreage would not be a significant loss of riparian habitat.

The feed gas trunkline would disturb an additional 346 acres which would be reclaimed after construction. The most significant riparian and cropland acreage to be disturbed is along Fontenelle and LaBarge creeks. The amount of disturbance of each type has not been determined. Disturbance in the wellfield is estimated at 737 acres for short-term disturbance and 376 acres for wellfield roads and production pads which would remain for the life of the project.

4.3.10 No Action Alternative

The No Action Alternative would result in no negative or positive impacts on soils and vegetation in the project area.

4.4 AGRICULTURE

4.4.1 Introduction

Impacts to agriculture would be primarily direct impacts from land disturbing activities and the indirect disruption of agricultural activities or livestock due to the presence of construction activities. Most of these impacts would be short-term since priority would be given to restoring agricultural facilities (e.g., irrigation diversions and fences) and all disturbed areas not needed for operations would be reclaimed within a year of construction. While the loss of *forage* and cropland is relatively small compared to the total available, a loss could be important to an individual rancher. Losses of greater than 1 percent of any allotment are indicated for each project. Each case should be reviewed by BLM to determine if allotment stocking and lease payments should be adjusted in order to avoid significantly affecting either the lessee or the condition of the remainder of an allotment. All compensation for private landowner losses are negotiated between the landowner and Amoco.

No field or farmstead windbreaks would be directly affected by any project construction activities. No stock watering areas would be directly affected by construction. Disturbance of livestock would be minimized by Amoco's efforts to prevent pipeline construction from limiting livestock access across the construction zone.

Since the inmigrant workforces for all projects would be relatively small compared to their anticipated place of residence, no conversion of cropland to other land uses as a result of urban expansion is expected. In fact, Amoco should discourage any construction of public or private facilities in response to projects due to their short-term nature.
The direct, adverse effects which would, to some degree, accompany all construction, are summarized in Table 4-16 along with general measures which would be used to minimize these impacts.

4.4.2 Fontenelle Project

No cropland would be impacted by this project. Table 4-17 summarizes long- and short-term loss of forage due to construction and operation of the Fontenelle Project. Very few *AUMs* will be lost and no losses would be significant.

4.4.3 Elk Basin Project

Summary Table 4-15 indicates that about 89 acres of cropland will be disturbed during construction of the

Table 4-16. Potential Adverse Effects of Project Construction on Agriculture and Measures Planned to Minimize Impacts.

Short- and long-term loss of cropland and cropland productivity in the right-of-way;	Minimize equipment traffic; segregate soil horizons; implement other "best practices" reclamation techniques; plant in spring if appropriate; compensate landowners for lost crop revenues;
Loss of forage for the period of construction and until regrowth and plantings restore productivity;	Implement "best practices" reclamation techniques; compensate private landowners for lost revenues;
Interference with livestock access to watering areas;	Maintain functional use of all watering devises during construction; provide trench crossings for water access with one day of access obstruction or provide alternate water source;
Loss of livestock in open trenches;	All ditches would be closed within 14 days; provide trench crossings in cattle trailing areas; compensate owners for loss of cattle;
Loss of agricultural productivity due to transportation delays and other disruptions of operations;	Notify users and landowners in advance of construction activities; maintain or replace fences and gates to preconstruction condition;

Table 4-17. Estimated Short-Term and Long-Term Loss of Forage for the Fontenelle Gas Gathering System and Gas Processing Plant. (a)

Resource Area	Allotment Number	Licensed Range Forage (AUMs)	AUMs Per Acre	Short-Term Disturbance (b) Milepost or Facility	Short-Term Disturbance (b) Acreage	Long-Term Disturbance (c) Milepost or Facility	Long-Term Disturbance (c) Acreage	Forage Loss (AUMs) Short-Term	Forage Loss (AUMs) Long-Term	Forage Loss (AUMs) Total	Forage Loss (% of Total Licensed) Short-Term	Forage Loss (% of Total Licensed) Long-Term	Stocking Rate (d)
Kemmerer	1112	1272	0.10	7.4 - 9.7	20.9	Block valve	0.1	5.71	0.00	5.71	0.45	<.01	0.28
				1.7w - 3.2w (e)	13.7	Well operations	1.0						
				5.9w - 7.2w	11.8								
				Staging area (f)	1.1								
				Road bore pit	0.6								
				Drill pads (g)	9								
	1113	11493	0.04	.5 - 7.4	62.8	1.4 mi. road	8.5	4.18	0.34	4.52	0.04	<.01	0.02
				0w - 1.7w	15.5								
				3.2w - 5.9w	24.6								
				Road bore pit	1.7								
	1306	30924	0.12	0 - .5	4.6	Plant site	40.0	0.55	5.96	6.51	<.01	0.02	0.02
						1.6 mi. road	9.7						
Green River	18 Mile	18994	0.08	13.4 - 16.8	30.9	Field roads	181.8	30.80	15.26	46.06	0.16	0.08	0.09
				Gas gathering	273.0	Well operations	9.0						
				Drill pads (g)	81.0								
	Lombard	6644	0.07	9.7 - 13.4	30.9	Block valve	0.1	2.25	0.01	2.25	0.03	<.01	0.03
				Staging area (f)	1.1								
						TOTALS:		43.48	21.57	65.06			

a = Source: Mileages calculated from maps and tables in the Soils, Vegetation and Agriculture Technical Report.
b = Short-term disturbances include all construction that will be reclaimed upon completion.
c = Long-term disturbances include block valves, station, plant sites, etc. that will remain for the life of the project.
d = Percent change in stocking rate is calculated on a minimum stocking rate for each allotment, i.e., licensed AUMs divided by the longest period allowed for grazing in each allotment.
e = Gas gathering system for west side of reservoir.
f = Green River Crossing.
g = Assumes 9 wells east of the reservoir and 1 well west of the reservoir.

Table 4-18. Estimated Short-Term and Long-Term Loss of Forage for the Elk Basin Trunk Pipeline and CO2 Recycle Plant. (a)

Resource Area	Allotment Number	Licensed Range Forage (AUMs)	AUMs Per Acre	Short-Term Disturbance (b): Milepost or Facility	Short-Term Disturbance (b): Acreage	Long-Term Disturbance (c): Milepost or Facility	Long-Term Disturbance (c): Acreage	Forage Loss (AUMs): Short-Term	Forage Loss (AUMs): Long-Term	Forage Loss (AUMs): Total	Forage Loss (% of Total Licensed): Short-Term	Forage Loss (% of Total Licensed): Long-Term	Stocking Rate (d)
Cody	0666	755	0.11	36.7 - 40.3	31.8			3.49		3.49	0.46		0.06
	1003	1143	0.06	0 - 1.9	17.29	Recycle plant	40.0	38.30	2.412	40.71	3.35	0.21	2.37
				Wellfield (e)	621.08	Meter station	0.2						
	1060	3885	0.07	29.0 - 36.7	70.1			4.90		4.90	0.13		0.03
	1061	200	0.03	8.7 - 12.8	4.1	Block valve	0.1	0.12	<.01	0.12	0.06	<.01	0.02
	1080	4463	0.08	1.9 - 8.7	61.9			9.86		9.86	0.22		0.06
				Wellfield (e)	61.43								
	1086	309	0.06	40.3 - 42.5	20.0			1.27		1.27	0.41		0.09
				Road bore pits	1.1								
	No allotment			12.8 - 29.0	147.4	Block valve	0.1						
				Road bore pits	2.3								
				43.5 - 44.3	7.3								
				Staging area (f)	2.3								
				Staging areas (g)	3.4								
Grass Creek	0508	7271	0.06	66.6 - 83.0	149.2			8.95		8.95	0.12		0.11
	0509	7663	0.08	49.1 - 66.6	159.3	Block valve	0.1	12.74	0.01	12.75	0.17	<.01	0.08
	0512	726	0.06	83.0 - 85.5	22.8	Block valve	0.1	1.37	0.01	1.37	0.19	<.01	0.08
	0549	27	0.08	44.3 - 44.8	4.6			0.36		0.36	1.35		0.03
	0674	1092	0.10	47.1 - 47.2	0.9			0.09		0.09	0.01		<.01
	No allotment			44.8 - 47.1	28.2	Block valve	0.1						
				47.2 - 49.1	17.3								
				85.5 - 87.6	19.1								
				Road bore pits	1.1								
				Staging area (h)	2.3								
Washakie	0048	2075	0.08	87.6 - 93.2	51.0			4.08		4.08	0.20		0.08
	0501	2957	0.20	98.8 - 106.5	70.1	Block valve	0.1	14.01	0.02	14.03	0.47	<.01	0.30
	0562	1934	0.17	97.7 - 98.8	10.0			1.70		1.70	0.09		0.01
	0571	503	0.12	95.8 - 96.1	2.7			0.33		0.33	0.07		0.01
	0591	476	0.09	96.1 - 97.7	14.6			1.31		1.31	0.28		0.07
	0603	431	0.19	93.2 - 95.8	23.7			4.50		4.50	1.04		0.17
	2513	30	0.12	112.9 - 114.2	11.8			1.42		1.42	4.73		4.73
	2514	473	0.05	109.6 - 109.8	1.8			2.78		2.78	0.59		0.59
				110.0 - 111.3	11.8								
				112.4 - 112.9	4.6								
				114.2 - 118.3	37.3								
	2542	96	0.22	111.3 - 112.4	10.0			2.20		2.20	2.29		2.29
	2543	156	0.22	108.6 - 109.6	9.1			2.40		2.40	1.54		1.54
				109.8 - 110.0	1.8								
	2547	396	0.18	106.5 - 108.6	19.1			3.44		3.44	0.87		0.58

Table 4-18. Continued.

Resource Area	Allotment Number	Licensed Range Forage (AUMs)	AUMs Per Acre	Short-Term Disturbance (b) Milepost or Facility	Short-Term Disturbance (b) Acreage	Long-Term Disturbance (c) Milepost or Facility	Long-Term Disturbance (c) Acreage	Forage Loss (AUMs) Short-Term	Forage Loss (AUMs) Long-Term	Forage Loss (AUMs) Total	Forage Loss (% of Total Licensed) Short-Term	Forage Loss (% of Total Licensed) Long-Term	Stocking Rate (d)
Lander	1312	2820	0.11	137.4 - 143.4	54.6	Block valve	0.1	6.01	0.01	6.02	0.21	<.01	0.21
	1315	108	0.08	133.8 - 134.2	3.6			0.29		0.29	0.27		0.01
	1316	170	0.06	134.2 - 136.3	19.1			1.15		1.15	0.67		0.11
	1322	726	0.16	136.3 - 137.4	10.0			1.60		1.60	0.22		0.18
	1325	272	0.04	129.0 - 133.8	43.7			1.75		1.75	0.64		0.13
	1332	159	0.05	128.6 - 129.0	3.6			0.18		0.18	0.11		0.04
	1337	125	0.02	118.3 - 122.4	37.3			0.75		0.75	0.60		0.60
	1353	416	0.05	123.2 - 126.1	26.4	Block valve	0.1	1.32	0.01	1.32	0.32	<.01	0.32
	1355	673	0.08	126.1 - 128.6	22.8			1.82		1.82	0.27		0.05
	1357	32	0.06	122.4 - 123.2	7.3			0.44		0.44	1.37		0.11
Platte River	0006	125	0.08	161.8 - 162.7	8.2	Block valve	0.1	0.80	0.01	0.81	0.64	0.01	0.13
				163.3 - 163.5	1.8								
	0007	229	0.11	163.5 - 167.9	40.0			4.40		4.40	1.92		0.40
	0008	16	0.01	158.0 - 161.8	34.6			0.35		0.35	2.16		0.18
	0013	1478	0.16	151.6 - 155.7	37.3			5.97		5.97	0.40		0.17
	0037	3734	0.10	155.7 - 158.0	20.9			5.57		5.57	0.15		0.15
				168.2 - 170.5	20.9								
				Road bore pits	1.1								
				174.4 - 175.8	12.7								
	0066	1232	0.11	147.8 - 151.6	34.6			3.80		3.80	0.31		0.21
	0130	1038	0.46	162.7 - 163.3	5.5			3.77		3.77	0.36		0.36
				167.9 - 168.2	2.7								
	0134	641	0.14	175.8 - 176.8	7.3	Origin station	0.1	1.02	0.01	1.03	0.16	<.01	0.16
	0148	3193	0.13	143.4 - 147.8	4.4			0.57		0.57	0.02		0.02
	0523	1270	0.14	170.5 - 174.4	35.5			4.97		4.97	0.39		0.39
							TOTALS:	166.16	2.48	168.64			

a = Mileages calculated from maps and tables in the Soils, Vegetation and Agriculture Technical Report.
b = Short-term disturbances include all construction that will be reclaimed upon completion.
c = Long-term disturbances include block valves, station, plant sites, etc. that will remain for the life of the project.
d = Percent change in stocking rate is calculated on a minimum stocking rate for each allotment, i.e., licensed AUMs divided by the longest period allowed for grazing in each allotment.
e = Acreage disturbed if all existing producing and injection pipelines are replaced; assumes a common trench 75' wide; assumes 91% of field in allotment #1003, 9% of field in allotment #1080.
f = Greybull River crossing staging area.
g = Shoshone River crossing and Sidon Canal boring staging areas.
h = Bighorn River crossing staging area.

Elk Basin Trunk Pipeline. This includes about 38 acres of *prime farmland*. Fifteen additional disturbed acres of prime farmland soils are not currently being farmed. The total disturbance of cropland accounts for less than 0.1 percent of cropland in each county.

In addition to cropland directly disturbed by construction, productivity of adjacent cropland may be affected in the season of construction by limiting availability of irrigation water while diversion ditches are interrupted. This impact can be minimized if irrigators are given sufficient notification of construction schedules and repair of diversions is expedited. Revegetation of the ditch crossings would require special attention to prevent future erosion. Amoco will negotiate with each irrigation district to determine which canals would be cut or bored.

About 124 AUMs would be lost (during pipeline construction) for the short-term and less than 1 AUM per year lost for the life of the pipeline facilities (i.e., block valves, origin and meter stations) (Table 4-18). An additional 42 AUMs would be lost due to short-term disturbance in the field. Long-term loss of forage due to plant construction would be limited to about 3 AUMs per year. Short-term loss would be less than 1 percent of licensed forage on most allotments. There should be no long-term AUM losses requiring adjustments in licensed AUMs.

The quantity of surface water currently available for irrigation and stock watering would be reduced by the project since the Elk Basin CO_2 flood would be a miscible flood. The wellfield-produced water that is currently discharged to the surface would be virtually eliminated.

Associated Projects. Based on an estimated average of 0.1 AUM per acre for the grazing allotments crossed by the Bairoil/Dakota Pipeline, about 64 AUMs would be lost during construction and revegetation of this pipeline. Long-term loss of forage would be limited to less than 1 AUM for block valves. Short-term loss of 0.4 acres of cropland would not represent a significant reduction in area cropland.

4.4.4 Beaver Creek Project

No cropland would be directly affected by project construction, although the Sweetwater River riparian zone, which would be crossed by the pipeline, may be used for hay production.

About 69 AUMs would be lost for the short-term (45 AUMs for pipeline construction and 24 AUMs for wellfield construction) and only about 5 AUMs lost for the life of the plant and pipeline facilities (Table 4-19). There would be no significant impacts on forage or stocking rate.

While no livestock watering areas would be physically destroyed by construction, the quantity of water currently available for stock watering would be reduced by the project since the Beaver Creek CO_2 flood would be a miscible flood. The wellfield-produced water that is currently discharged to the surface would be virtually eliminated.

4.4.5 Little Buffalo Basin Project

About 26 acres of cropland would be disturbed during spur pipeline construction, including 20 acres of prime farmland (Table 4-15). This cropland accounts for less than 0.1 percent of cropland in each affected county.

In addition to cropland directly disturbed by construction, productivity of adjacent cropland may be affected by limiting availability of irrigation water while diversion ditches are interrupted. This impact can be minimized if irrigators

Table 4-19. Estimated Short-Term and Long-Term Loss of Forage for the Beaver Creek Trunk Pipeline and CO2 Recycle Plant. (a)

Resource Area	Allotment Number	Licensed Range Forage (AUMs)	AUMs Per Acre	Short-Term Disturbance (b) Milepost or Facility	Short-Term Disturbance (b) Acreage	Long-Term Disturbance (c) Milepost or Facility	Long-Term Disturbance (c) Acreage	Forage Loss (AUMs) Short-Term	Forage Loss (AUMs) Long-Term	Forage Loss (AUMs) Total	Forage Loss (% of Total Licensed) Short-Term	Forage Loss (% of Total Licensed) Long-Term	Stocking Rate (d)
Lander	1703	14122	0.14	13.3 - 24.7	103.7			14.52		14.52	0.10		0.06
	1704	1956	0.11	25.1 - 29.3	38.2			4.20		4.20	0.21		0.17
	1707	183	0.08	29.6 - 30.8	10.9			0.87		0.87	0.48		0.12
	1715	14	0.03	29.3 - 29.6	2.7			0.08		0.08	0.59		0.22
	1801	8824	0.11	0 - 8.8	80.1	Recycle plant	40.0	30.46	4.42	34.88	0.35	0.05	0.20
				Road bore pits	1.1	Meter station	0.2						
				Wellfield (e)	195.7								
	1802	1163	0.08	8.8 - 13.3	41.0			3.28		3.28	0.28		0.11
	1805	734	0.11	Wellfield (e)	13.7			1.50		1.50	0.20		0.09
	1812	516	0.03	Wellfield (e)	18.2			0.55		0.55	0.11		0.05
	2001	47340	0.15	33.9 - 35.4	13.7	Origin station	0.1	3.41	0.02	3.43	0.01	<.01	<.01
				41.4 - 41.7	2.7								
				43.8 - 44.5	6.4								
	2004	651	0.10	30.8 - 31.6	7.3			2.18		2.18	0.34		0.32
				32.3 - 33.9	14.6								
				Road bore pits	1.1								
	2011	296	0.16	31.6 - 32.3	6.4			1.02		1.02	0.34		0.04
	2012	377	0.07	37.3 - 41.4	37.3			2.61		2.61	0.69		0.06
	2013	1727	0.13	35.4 - 37.3	17.3			2.25		2.25	0.13		0.07
	2023	67	0.10	41.7 - 43.8	19.1			1.91		1.91	2.85		0.24
	No allotment			24.7 - 25.1	3.6								
				Staging area (f)	2.3								
	Unknown					Block valve (g)	0.1		0.02	0.02			
							TOTALS:	68.85	4.45	73.30			

a = Source: Mileages calculated from maps and tables in the Soil, Vegetation and Agriculture Technical Report.
b = Short-term disturbances include all construction that will be reclaimed upon completion.
c = Long-term disturbances include block valves, station, plant sites, etc. that will remain for the life of the project.
d = Percent change in stocking rate is calculated on a minimum stocking rate for each allotment, i.e., licensed AUMs divided by the longest period allowed for grazing in each allotment.
e = Acreage disturbed if all existing producing and injection pipelines are replaced; assumes a common trench 75' wide; assumes 86% of the field in allotment #1801, 8% in allotment #1812 and 6% in allotment #1805.
f = Sweetwater River crossing staging area.
g = Since the block valve location has not been determined, the most productive allotment AUMs/acre (.16) was used to estimate forage loss.

are given sufficient notification of construction schedules and repair of diversions is expedited. Revegetation of the ditch crossings would require special attention to prevent future erosion.

Since the Little Buffalo Basin CO_2 flood would be an immiscible flood, the amount of wellfield-produced water that is discharged to the surface and used by downstream irrigators is not expected to significantly change as a result of this project.

About 152 AUMs would be lost for the short-term (128 AUMs for pipeline and 24 AUMs for wellfield construction). Only about 7 AUMs would be lost for the life of the plant and pipeline facilities (Table 4-20). The total disturbance (long- and short-term) would be over 4 percent of licensed forage on three allotments (#0594 [4%], #0564 [6%] and #2510 [10%]). The impact to these allotments is due primarily to replacement of production and injection pipeline within the Little Buffalo Basin Field.

4.4.6 Salt Creek Project

No cropland would be affected by project construction. About 235 AUMs would be lost for the short-term (8 AUMs for pipeline and 227 AUMs for wellfield construction). Only about 5 AUMs would be lost for the life of the plant and pipeline facilities (Table 4-21). The short-term forage loss would be about 3 percent of allotment #0154 and about 24 percent of allotment #0039. The latter is primarily due to replacement of production and injection pipelines within the Salt Creek Field. While replacement of these lines is expected to take four years (i.e., only one quarter of the area disturbed each year), reclaimed areas cannot be expected to be available for full grazing pressure for at least a few years. The impact on stocking rates in the Salt Creek Field would be about 16 animal units, or about 25 percent of the current rate.

Since the Salt Creek CO_2 flood would be an immiscible flood, the amount of wellfield-produced water that is discharged to the surface is not expected to change.

Associated Projects. Based on an estimated average of 0.1 AUM per acre for the grazing allotments crossed by the Bairoil/Dakota Pipeline, about 33 AUMs would be lost during construction and revegetation of this pipeline. Long-term loss of forage would be limited to less than 1 AUM for block valves. There would be no loss of crop production.

4.4.7 Beaver Creek Alternative

No cropland will be directly affected by construction of this alternative pipeline section. Table 4-22 summarizes expected long- and short-term loss of forage due to construction and operation of the Beaver Creek Alternative Pipeline. About 24 AUMs would be lost for the short-term and less than 1 AUM lost for the life of the project due to a block valve.

With addition of the impacts associated with the Beaver Creek Trunk Pipeline and the Elk Basin Trunk Pipeline (mileposts 0 - 132), the total short-term loss of forage for the Beaver Creek Alternative Pipeline would be 151 AUMs. About one AUM would be lost for the life of the project due to block valves.

4.4.8 Frontier/Casper Alternative

No cropland would be affected by construction of the Frontier Access Section of this alternative pipeline alignment. About 4.6 acres of cropland would be temporarily disturbed near Casper Creek in the Casper Section.

Table 4-20. Estimated Short-Term and Long-Term Loss of Forage for the Little Buffalo Basin Spur Pipeline and CO2 Recycle Plant. (a)

Resource Area	Allotment Number	Licensed Range Forage (AUMs)	AUMs Per Acre	Short-Term Disturbance (b): Milepost or Facility	Short-Term Disturbance (b): Acreage	Long-Term Disturbance (c): Milepost or Facility	Long-Term Disturbance (c): Acreage	Forage Loss (AUMs): Short-Term	Forage Loss (AUMs): Long-Term	Forage Loss (AUMs): Total	Forage Loss (% of Total Licensed): Short-Term	Forage Loss (% of Total Licensed): Long-Term	Stocking Rate (d)
Grass Creek	0508	7271	0.06	24.2 - 24.5	2.7	Origin station	0.1	4.66	0.01	4.66	0.06	<.01	0.06
				27.9 - 36.0	73.7								
				Road bore pits	1.1								
	0545	982	0.15	6.6 - 9.3	24.6			5.22		5.22	0.53		0.33
				10.2 - 11.2	9.1								
				Road bore pits	1.1								
	0564	562	0.23	2.4 - 2.5	0.9			32.23		32.23	5.74		5.74
				Wellfield (e)	139.2								
	0579	2316	0.15	9.3 - 10.2	8.2			3.14		3.14	0.14		0.07
				11.2 - 12.0	7.3								
				13.7 - 14.3	5.5								
	0594	567	0.17	0 - 0.6	5.5	Recycle plant	40.0	20.42	6.83	27.25	3.60	1.21	1.20
				Wellfield (e)	114.7	Meter station	0.2						
	0604	6600	0.12	14.8 - 18.1	30.0			3.74		3.74	0.06		0.03
				Road bore pits	1.1								
	0605	7778	0.12	0.6 - 2.4	16.4			48.70		48.70	0.63		0.37
				2.5 - 6.6	37.3								
				Wellfield (e)	352.2								
	2510	347	0.16	Wellfield (e)	212.9			34.070		34.07	9.82		9.82
	No allotment			12.0 - 13.7	15.5								
				14.3 - 14.8	4.6								
				18.1 - 21.2	28.2								
				22.2 - 24.2	18.2								
				24.5 - 27.9	30.9								
	Killifish Excl.			21.2 - 22.2	9.1								
	Unknown					Block valve (f)	0.1		0.02	0.02			
							TOTALS:	152.18	6.86	159.05			

a = Source: Mileages calculated from maps and tables in the Soils, Vegetation and Agriculture Technical Reports.
b = Short-term disturbances include all construction that will be reclaimed upon completion.
c = Long-term disturbances include block valves, station, plant sites, etc. that will remain for the life of the project.
d = Percent change in stocking rate is calculated on a minimum stocking rate for each allotment, i.e., licensed AUMs divided by the longest period allowed for grazing in each allotment.
e = Acreage disturbed if all existing producing and injection pipelines are replaced; assumes a common trench 75' wide; assumes 43% of field in allotment #0605, 26% in allotment #2510, 17% in allotment #0564 and 14% in allotment #0594.
f = Since the block valve location has not been determined, the most productive allotment AUMs/acre (.24) was used to estimate forage loss.

Table 4-21. Estimated Short-Term and Long-Term Loss of Forage for the Salt Creek Spur Pipeline and CO2 Recycle Plant (a)

Resource Area	Allotment Number	Licensed Range Forage (AUMs)	AUMs Per Acre	Short-Term Disturbance (b) Milepost or Facility	Short-Term Disturbance (b) Acreage	Long-Term Disturbance (c) Milepost or Facility	Long-Term Disturbance (c) Acreage	Forage Loss (AUMs) Short-Term	Forage Loss (AUMs) Long-Term	Forage Loss (AUMs) Total	Forage Loss (% of Total Licensed) Short-Term	Forage Loss (% of Total Licensed) Long-Term	Stocking Rate (d)
Platte River	SDW	5000	0.10	6.9 - 8.3	12.7	Meter station	0.2	1.67	0.02	1.69	0.03	<.01	<.01
				8.8 - 9.2	4.0								
	0039	760	0.13	0 - 1.8	16.4	Origin station	0.1	182.06	5.21	187.28	23.96	0.69	24.64
				Wellfield (e)	1384.1	Recycle plant	40.0						
	0115	848	0.02	1.8 - 2.7	8.2			3.00		3.00	0.35		0.35
				Wellfield (e)	141.96								
	0118	262	0.07	8.3 - 8.8	4.6			0.32		0.32	0.12		0.02
	0153	999	0.18	Wellfield (e)	248.43			44.72		44.72	4.48		1.49
	0154	111	0.08	2.7 - 6.9	38.2			3.15		3.15	2.83		0.47
				Road bore pits	1.1								
	Unknown					Block valve (f)	0.1		0.02	0.02			
						TOTALS:		234.92	5.25	240.16			

a = Source: Mileages calculated from maps and tables in the Soils, Vegetation and Agriculture Technical Reports.

b = Short-term disturbances include all construction that will be reclaimed upon completion.

c = Long-term disturbances include station, plant sites, etc. that will remain for the life of the project.

d = Percent change in stocking rate is calculated on a minimum stocking rate for each allotment, i.e., licensed AUMs divided by the longest period allowed for grazing in each allotment.

e = Acreage disturbed if all existing producing and injection pipelines are replaced; assumes a common trench 75' wide. assumes 78% of the field in allotment #0039, 14% in allotment #0153 and 8% in allotment #0115

f = Since the block valve location has not been determined, the most productive allotment AUMs/acre (.18) was used to estimate forage loss.

Table 4-22. Estimated Short-Term and Long-Term Loss of Forage for the Beaver Creek Alternative. (a)

Resource Area	Allotment Number	Licensed Range Forage (AUMs)	AUMs Per Acre	Short-Term Disturbance (b) Milepost or Facility	Short-Term Disturbance (b) Acreage	Long-Term Disturbance (c) Milepost or Facility	Long-Term Disturbance (c) Acreage	Forage Loss (AUMs) Short-Term	Forage Loss (AUMs) Long-Term	Forage Loss (AUMs) Total	Forage Loss (% of Total Licensed) Short-Term	Forage Loss (% of Total Licensed) Long-Term	Stocking Rate (d)
Lander	1324	2775	0.09	34.1 - 37.1	27.3			2.46		2.46	0.09		0.09
	1325	272	0.04	53.5 - 55.0	13.7			0.55		0.55	0.20		0.04
	1330	420	0.07	50.3 - 53.5	29.12			2.04		2.04	0.49		0.20
	1333	1487	0.09	44.5 - 50.3	52.8			4.75		4.75	0.32		0.17
	1335	912	0.11	39.2 - 44.5	48.23			5.31		5.31	0.58		0.15
	1339	490	0.10	32.7 - 34.1	12.74			1.27		1.27	0.26		0.07
	1351	303	0.09	37.1 - 39.2	19.11			1.72		1.72	0.57		0.09
	1404	397	0.11	27.2 - 29.6	3.64			0.40		0.40	0.10		0.06
	1406	817	0.04	29.6 - 32.7	28.21			1.13		1.13	0.14		0.07
	1407	3962	0.08	26.5 - 27.2	6.37	Block valve	0.1	0.51	0.01	0.52	0.01	<.01	0.01
	1801	8824	0.11	0 - 2.8	25.48			2.80		2.80	0.03		0.02
	1805	734	0.11	2.8 - 4.3	13.65			1.50		1.50	0.20		0.09
	No allotment			4.3 - 26.5									
							TOTALS:	24.43	0.01	24.44			

a = Source: Mileages calculated from BLM data.

b = Short-term disturbances include all construction that will be reclaimed upon completion.

c = Long-term disturbances include block valves, station, plant sites, etc. that will remain for the life of the project.

d = Percent change in stocking rate is calculated on a minimum stocking rate for each allotment, i.e., licensed AUMs divided by the longest period allowed for grazing in each allotment.

Table 4-23 summarizes expected long- and short-term loss of forage due to construction and operation of the Frontier/Casper Alternative Pipeline. The short-term forage loss would be about 2 to 3 percent on two allotments.

4.4.9 Exxon Alternative CO_2 Supply

Based on an estimated average of 0.12 AUM per acre for the grazing allotments disturbed by the Exxon Project, about 24 AUMs would be lost per year at the plant site and about 45 per year at the wellfield for the life of the project. Short-term loss is estimated at 42 and 88 AUMs for pipeline and wellfield disturbance, respectively, that would be reclaimed after construction. The total disturbance of irrigated cropland was estimated as 77 acres in the Riley Ridge DEIS (BLM, 1983d). While much of this cropland is on perennial streams that would be crossed by the Phase II trunkline, the cropland disturbance in Phase II is likely to be somewhat less since wellfield disturbance will be less.

4.4.10 No Action Alternative

No impacts to agriculture would be associated with implementation of the No Action Alternative.

4.5 WATER RESOURCES

4.5.1 Introduction

The Proposed Actions and their alternatives have a potential for impacting surface water resources. Potential impacts are:

- o Decrease in water quality (increased *total suspended solids (TSS)* and decreased oxygen) by additions of sediments during construction;
- o Decrease in water quality due to removal of riparian vegetation and/or increased erosion from upland areas;
- o Risk of physical disturbance of stream beds and changes in TSS, oxygen concentrations, temperature and *pH* due to a pipeline rupture;
- o Changes in *floodplains* such that flood flows are impeded; and
- o Use of water in trench dewatering and dust control during construction and hydrostatic testing.

The major impacts to water resources would be during construction of pipelines across perennial streams. Inappropriate construction techniques in intermittent or ephemeral drainages can, however, result in significant additions of sediment, during large flow events, from scour after construction. Unnecessary disturbance to both perennial and intermittent or *ephemeral streams* would be minimized through application of the construction techniques and mitigation measures listed in Chapters 2 and 5 of this DEIS. Many of these mitigating measures are an integral part of Amoco's Proposed Actions and others are required by BLM or other agencies to protect water resources. With rigorous implementation of these mitigation measures and construction techniques described by Amoco, no significant impacts to water quality are expected in the rivers or perennial streams affected by Proposed Action components or their alternatives.

Some reduction in oxygen concentration would be expected in the vicinity of trenching operations at river crossings during construction, but oxygen depletion would be limited to the immediate trench area. Temporary turbidity increases would also occur with sediment loading. Intermittent and ephemeral streams would be crossed when little or no surface water is present, so no significant sediment loading would be expected. The in-water portion of perennial

Table 4-23. Estimated Short-Term and Long-Term Loss of Forage for the Frontier/Casper Alternative. (a)

				Short-Term Disturbance (b)		Long-Term Disturbance (c)		Forage Loss (AUMs)			Forage Loss (% of Total Licensed)		Stocking Rate
Resource Area	Allotment Number	Licensed Range Forage (AUMs)	AUMs Per Acre	Milepost or Facility	Acreage	Milepost or Facility	Acreage	Short-Term	Long-Term	Total	Short-Term	Long-Term	(d)
FRONTIER ACCESS SECTION													
Kemmerer	1306	30924	0.12	0 - 5.8	52.8			6.33		6.33	0.02		0.02
Green River	3018	213106	0.10	5.8 - 24.0	165.6			16.90		16.90	0.01		0.01
CASPER SECTION													
Platte River	0039	3237	0.15	0 - 6.6	60.06			9.01		9.01	0.28		0.28
	0068	2037	0.14	6.6 - 11.8	47.32			6.62		6.62	0.33		0.33
	0082	1305	0.21	25.6 - 25.8	1.82			0.38		0.38	0.03		0.03
	0096	919	0.21	25.8 - 49.5	124.67			26.18		26.18	2.85		2.85
	0115	4146	0.15	11.8 - 19.4	69.16			10.37		10.37	0.25		0.25
	0136	760	0.23	19.4 - 25.6	56.42	Block valve	0.1	12.98	0.02	13.00	1.71	<.01	0.29
							TOTALS:	88.78	0.02	88.81			

a = Source: Mileages calculated from BLM data.
b = Short-term disturbances include all construction that will be reclaimed upon completion.
c = Long-term disturbances include block valves, station, plant sites, etc. that will remain for the life of the project.
d = Percent change in stocking rate is calculated on a minimum stocking rate for each allotment, i.e., licensed AUMs divided by the longest period allowed for grazing in each allotment.

stream crossings would be accomplished within one week at low flow, but would be timed so as to not interfere with game fish spawning. Turbidity standards may be violated for a short time during the in-water construction, both at the crossing site and for one to three miles downstream. The turbidity plume would dissipate as it is moved downstream, and would be present only during actual construction.

For all Proposed Actions and alternative pipeline alignments, the right-of-way routes were selected to follow existing pipeline corridors, where possible, in order to minimize disturbance of natural terrain. While contacting and rupturing an existing adjacent pipeline during construction could occur anywhere, such an accident would be particularly destructive at a stream crossing. Such accidents are avoidable with proper notification of construction crews of the precise location of existing pipelines. The 50-foot construction off-set from existing pipelines requested by Amoco should also aid in reducing the potential for any damage to adjacent pipelines.

Construction in upland areas would not contribute a significant amount of sediment to waterways, with the erosion control measures identified in Appendix 1 and proposed by Amoco in Chapter 2 of this DEIS. Maintenance of a buffer strip of vegetation between river crossing staging areas and the high water line along with strictly limiting blading of the right-of-way in riparian zones will also limit both long- and short-term sediment contribution to area streams. As required, straw bale filters would be installed to prevent suspended sediments from reaching downstream waterways.

Non-routine events, such as a rupture or a leak in a CO_2 pipeline, could significantly impact a stream. Should a break occur under a waterway, the CO_2 would expand to a gaseous state releasing a large amount of energy stored as heat of vaporization. The pressure release within the pipeline (approximately 2,000 *psi*), would scour sediments from the stream bed, and send a plume of water, bed material and CO_2 into the atmosphere. Suspended sediment in the stream would increase and dissolved CO_2 would lower the pH of the water. As the gas expands from the release it would lower the water temperature.

While a pipeline rupture would be locally catastrophic (i.e., affecting one to three miles of stream), the impacts should be very short-term (BLM, 1985a). Block valves will be installed at approximately 20-mile intervals on each pipeline in compliance with *ANSI* B31.8. Block valves would be automated and would close if the pipe failed. Closure of the valves would limit the amount of CO_2 released. Depending on the discharge of the stream during a rupture, CO_2 released into the water column would be diluted. Since natural alkalinity of area streams and of the streambed material would buffer the added CO_2, the potential for significant reduction of pH is negligible.

A small leak could release gas at a rate too small to trigger closure of the block valves. As such, the amount of CO_2 entering the stream would bubble through the overlying streambed material and water column, both buffering media. Most waterways in the project areas are ice-covered in at least some years. Gas released from a rupture would likely vent through cracks in the ice, or by breaking the ice sheet. A slow leak under ice could reduce the pH of isolated pockets of stream, if that pocket were sufficiently small and if there were no water movement.

Construction of pipelines would not affect the characteristics of any floodplain such that flood flows would be impeded. The only permanent pipeline structures that may be con-

structed in floodplains are block valves.

In the Raptor Field it is impossible to predict the impact of well drilling on surface water quality because the location of development wells is not known. The types of impacts that could occur are similar to pipeline construction (e.g., increased sediment loading from road and drill pad construction) with the additional potential for contamination of surface and shallow groundwater by failure of drilling reserve pits or spills from trucks transporting materials to well sites.

Contamination of groundwater could occur from leaking of reserve pits and as a result of drilling activities in the Raptor Field. Drilling wells through water and oil-bearing formations can also cause contamination of fresh water by introducing oil and high concentrations of dissolved salts. The degree of fresh water aquifer contamination is expected to be small given current well drilling protective measures and regulations developed by the Wyoming Oil and Gas Conservation Commission and the BLM (BLM, 1983c). Oil and gas well drilling is regulated by both agencies.

Water required for dust control during construction and hydrostatic testing of pipelines will be purchased or acquired through permitting with the State Engineer's office.

4.5.2 Fontenelle Project

No significant impacts to water quality would occur in Slate Creek or the Green River during construction of the gas gathering system. During operation, a rupture or leak in the pipeline would result in a significant but short-term impact on water quality. Because of the system pressure, the escaped gas would erupt from the surface in a plume, disrupting streambed material and increasing suspended sediments. The gas gathering system would contain approximately 1 percent H_2S. If a rupture occurred, most of the H_2S and CO_2 would be vented to the atmosphere. Some of the gas would go into solution, killing any fish in the immediate vicinity. Contaminated water could not be used for domestic or municipal use until toxic levels are reduced by dispersion or dilution. Such use does not, however, occur in the vicinity of the pipeline crossing. Block valves, automated and designed to close upon pipe failure, would be installed on both sides of the Green River crossing to significantly reduce the quantity of gas released in the event of an accident.

The dissolved H_2S would be quickly diluted by the current in the Green River, and the material would be oxidized to non-poisonous products. Dissolved CO_2 would lower the pH and temperature of the water, but the combination of dilution and the river water's buffering capacity would minimize these effects.

The Fontenelle Plant would disturb approximately 40 acres. More than half of the 160-acre site designated for the plant is within the 100-year floodplain of Shute Creek. Careful siting of the plant would be necessary to assure that flood flows would not be impeded.

In order to avoid emitting SO_2 and H_2S to the atmosphere, the acid gas waste stream from the plant will be reinjected into the Madison Formation at the Fontenelle Plant site. In this area the Madison Formation is a hydrocarbon bearing formation at an estimated depth of at least 15,000 feet. Because of the depth and the presence of significant quantities of hydrocarbons, the Madison Formation in this location is not considered a potable aquifer.

Some concern has been raised regarding the possible contamination of shallower groundwater aquifers above the Madison Formation. The presence of such aquifers and the design of

the injection system would be reviewed by WDEQ--Water Quality Division pursuant to the federal Safe Drinking Water Act. The purpose of this review is to assure that any potable aquifers penetrated by the well bore would be protected during operation of the reinjection well.

4.5.3 Elk Basin Project

The general construction and operation impacts to perennial streams described in Section 4.5.1 could affect 12 streams along the Elk Basin Trunk Pipeline. All crossings would occur adjacent to existing pipelines.

The Elk Basin Field is largely drained by Silver Tip Creek, which flows north into Montana. The field presently discharges produced water under an *NPDES* Permit. The CO_2 project would return most or all of this water to the hydrocarbon reservoir. The quantity of water in Silver Tip Creek would be reduced by not releasing the produced water; but since the discharged water is very high in *total dissolved solids*, the water quality of Silver Tip Creek would be greatly improved.

Associated Projects. The general construction and operation impacts to perennial streams described in Section 4.5.1 could affect seven streams along the Bairoil/Dakota Pipeline from mileposts 112 to 185. Three of these crossings are not in existing corridors.

4.5.4 Beaver Creek Project

The general construction and operation impacts to perennial streams described in Section 4.5.1 could affect two streams. Crossing of the Sweetwater River and Crooks Creek would occur alongside an existing pipeline.

The Beaver Creek Field is largely drained by Beaver Creek. The field presently discharges produced water under an NPDES Permit. The CO_2 project would return most or all of this water to the hydrocarbon reservoir. The produced water is very high in total dissolved solids. Water quality would be improved by discontinuing the discharge, but the quantity of water in Beaver Creek would decrease.

4.5.5 Little Buffalo Basin Project

The general construction and operation impacts to perennial streams described in Section 4.5.1 could affect two streams along the spur pipeline. The Little Buffalo Basin Field is partially drained by Buffalo Creek. The field presently discharges produced water under an NPDES Permit. The CO_2 project would not significantly affect that discharge.

4.5.6 Salt Creek Project

The Salt Creek Pipeline would not cross any perennial streams. No impacts to water resources would be expected from the construction or operation of the project.

The Salt Creek Project would be constructed within the Salt Creek Area of Critical Environmental Concern (ACEC). Construction in ephemeral drainages would not have a significant adverse effect on the ACEC goal to enhance water quality with effective implementation of erosion controls discussed in Appendix 1 and Chapter 2 of this DEIS.

4.5.7 Beaver Creek Alternative

The Beaver Creek Alternative alignment crossings of Bridger Creek and Badwater Creek would occur adjacent to existing pipelines. The north option for joining the Beaver Creek Alternative to the Elk Basin route (at Elk Basin Trunk Pipeline milepost 132) would parallel Bridger Creek for

about two miles (mileposts 52 through 54). A realignment of this option to follow the Bridger Creek Road north to intersect the Elk Basin route at milepost 128 would eliminate four crossings of Bridger Creek and reduce potential impacts to water quality. The south option would cross Bridger Creek twice, once along the Beaver Creek Alternative and once after the junction with the Elk Basin route.

The Beaver Creek Alternative would have the additional impacts described in Section 4.5.2 and 4.5.4 for the Beaver Creek and Elk Basin trunk pipelines.

4.5.8 Frontier/Casper Alternative

Since the Frontier Access Section of the alternative would not cross any perennial streams, impacts to water resources from the construction or operation of the alternative should be minor. The Casper Section would cross Casper Creek within 500 feet of a railroad. The railroad crossing would require a bore pit within the riparian zone. This bore pit would disturb more riparian vegetation than a stream crossing without an adjacent railroad bore pit and would increase short-term impacts to water quality. Since the creek crossing is not in an existing pipeline corridor, the crossing should be realigned such that the bore pit does not contribute unnecessary sediments to Casper Creek and such that riparian vegetation disturbance is minimized. At the crossing, banks should be stabilized to prevent erosion. The POD would discuss details of the realignment after site-specific studies are conducted.

While the northern portion of the Casper Section is within the Salt Creek ACEC, the project would not have a significant negative or positive effect on the ACEC goal to enhance water quality.

4.5.9 Exxon Alternative CO_2 Supply

The Phase II Shute Creek Plant site would not impact the 100-year floodplain of Shute Creek. No impacts would result from plant construction, assuming injection wells used for water disposal would be properly cased and sealed to prevent impacts to groundwater aquifers (BLM, 1983c). All wastewater injection wells would be permitted by WDEQ--Water Quality Division.

The general construction and operation impacts to perennial streams described in Section 4.5.1 could affect four streams along the feed gas trunkline. The impacts on these streams would be similar to those described for the Green River crossing in the Fontenelle Project (see Section 4.5.2). The concentration of H_2S in Exxon's pipeline is, however, significantly higher.

4.5.10 No Action Alternative

Implementation of the No Action Alternative would not affect water resources of the project or alternative areas since none of the projects would be constructed.

4.6 WILDLIFE

4.6.1 Introduction

Terrestrial Wildlife

The major potential impacts to terrestrial wildlife would be:

- Destruction of animals and/or habitat during construction;
- Destruction of wildlife due to well blowouts or pipeline ruptures;
- Wanton killing and harassment of wildlife by construction workers; and
- Vehicle-wildlife collisions.

Habitat disturbances associated with the proposed projects and their alternatives include construction of pipelines, gas plants and activities within the wellfields, including replacement of production and injection pipelines. The impacts of this construction on wildlife is dependent on the types, amounts and timing of habitats disturbed.

Tables 3-15 through 3-18 provide the important known wildlife habitats that may be affected by each of the proposed projects. These habitats include crucial big game winter ranges; known prairie dog concentrations; sage grouse nesting and rearing habitats and known raptor nests.

Approximately 9.1 acres of habitat will be disturbed per mile of pipeline constructed. This disturbance is considered short-term since the pipelines will be reclaimed once constructed. Habitat disturbance associated with gas plant construction is considered long-term since the plants will stay in place for the life of the project. The plants will occupy 40 acres in each wellfield. Wellfield activities are considered short-term in existing oil fields that will be flooded with CO_2 and long-term for the Raptor Field since new roads and facilities will need to be constructed to develop the field.

Impacts to wildlife from construction activities can be reduced by restricting construction in areas important to wildlife or during critical seasons or periods such as during winter, nesting and breeding periods or in calving and fawning areas. Impacts can also be reduced by minimizing disturbed areas, using the proper reclamation techniques and ensuring immediate reclamation after construction is complete.

Additional surveys for black-footed ferrets, active raptor nests or sage grouse *leks* will help determine if these species occur in the areas to be disturbed and if they will actually be impacted. Surveys for black-footed ferrets will be conducted in the year of construction in all prairie dog towns within 0.5 miles of the pipeline. During the season of construction surveys will be conducted for raptors and sage grouse. The surveys can also validate baseline data and determine if construction activities must adhere to seasonal restrictions or if other mitigation measures can be applied to protect wildlife. If construction is to occur when standard seasonal restrictions would normally apply, Amoco will acquire approval in writing from the Authorized Officer before construction begins.

Small mammals, reptiles and amphibians residing on the right-of-way of pipelines or in other construction areas would be killed or displaced by construction activities. The amount of habitat present that would be disturbed is small, and these species generally have a high reproductive potential, allowing the rapid recolonization of the right-of-way in the season following construction. These losses would be short-term and not significant.

Increases in poaching and harassment of wildlife would occur with the proposed projects and alternatives. But, since most of the workforce is expected to be drawn from the local labor pool, activities of local hires are contained in the current baseline levels and are not expected to increase. Also, for pipeline projects the work is spread over a large geographic area and workers should not be in one area long enough to significantly increase the levels. Guns and dogs will not be allowed on the work site and any harassment of wildlife by workers will be prohibited and strictly enforced.

Increases in vehicle-wildlife collisions are also likely to occur in wellfields and along transportation routes to project sites. The number of road kills can be expected to increase proportionally with traffic increases in each area.

However, the placement of "deer whistles" on vehicles could decrease the number of wildlife collisions.

Aquatic Wildlife

Fishes would be expected to move away from the disturbance caused by construction of the pipeline through a stream. Impacts to fisheries could occur from disturbance of spawning or of eggs or larvae in the sediment. Construction would be scheduled such that neither spring spawners (rainbow trout) nor fall spawners (brook and brown trout) would be significantly affected. If impacts occurred despite the seasonal restrictions, they would affect only one year class, and only in the vicinity of the crossing.

Stream invertebrates living on the crossing sites of perennial streams would be displaced by construction. Animals crushed would be lost to the system, while animals displaced and carried downstream would occupy a different area or be consumed by other stream residents. Crossing of most waterways should be accomplished within one day. Recolonization by upstream drift would be expected, limiting impacts to the short-term. Intermittent and ephemeral streams would be primarily crossed during periods of no water, which would not interfere with their use as seasonal aquatic habitats. Chronic sedimentation can also impact aquatic communities. Sediment loading from these projects would be limited to time of construction, as required reclamation techniques would limit erosion (see Section 4.5).

Rupture of a high pressure CO_2 pipeline in a stream could force overlying sediments and water into the air. The CO_2 released would be both expelled into the air and mixed violently with the water column. The physical impact from such a rupture would kill all fish in the immediate vicinity of the rupture. Some CO_2 would go into solution, forming a widening and deepening plume as it dispersed and mixed with the surrounding water. This CO_2 has the potential to lower the water temperature and to form a weak carbonic acid which can lower the water's pH. CO_2 is slightly soluble in water, at just over 1 mg/l under standard conditions. Fishes are able to adjust to increases in CO_2 levels as high as 60 mg/l (BLM, 1984b). Above this level fishes can no longer extract oxygen from the water and will suffocate.

A pipeline rupture would initiate closure of the block valves, located at approximately 20-mile intervals and at both sides of the Green River river crossing. The closure of block valves would limit the amount of CO_2 entering a stream. The concentration of CO_2 in the water column would be diluted as the plume moved downstream and reductions in pH and temperature would only be expected in the immediate vicinity of the rupture, as the buffering capacity of the stream and mixing with surrounding water would quickly ameliorate such changes. Given the presence of block valves, the mobility of fishes, the diluting effect of the waterway and the small likelihood of a rupture, the potential for significant fish loss is small.

A less serious failure could also impact aquatic resources. An instream pipeline leak, too small to cause closure of the block valves (less than 150 psi), would continue to leak into the waterway but at a very slow rate. The worst conditions for such a leak would be at the beginning of ice cover. In ice-covered waterways, fishes frequently collect in pools with sufficient free water. A fish kill in such a pool could occur if the ice cover were sufficiently tight and if the leak occurred over a sufficiently long time to allow the CO_2 to overcome the buffering capacity of the water and to accumulate. In the event of a fish kill, Amoco would reimburse the Wyoming Game and Fish Department for any losses.

Threatened or Endangered Species

Any impacts to the bald eagle or peregrine falcon from the Proposed Actions would be considered significant. No active nests are known in the vicinity of the Proposed Actions. However, bald eagles concentrate along the Green River and along its tributaries. In the winter, bald eagles concentrate on the large open water areas of the Green River. A sour gas rupture near the Green River crossing could kill any bald eagles in the area. Whooping cranes use the area along the Green River, Fontenelle Creek, Hams Fork and South Piney Creek during their migration in April, June and September. The cranes are part of the Gray's Lake National Wildlife Refuge population which migrate to New Mexico. No nesting has occurred among this population in the Green River area.

Any black-footed ferrets in the area could be killed by trenching equipment. Known concentrations of prairie dogs have been mapped, and surveys for additional prairie dog colonies and black-footed ferrets by approved survey teams using approved methodology will be done prior to construction. If ferrets are not present, removal of prairie dog habitat by construction is a temporary (one-year maximum) impact, and would not be significant, given the abundance of prairie dog populations.

Candidate species include five species of birds, one mammal, and one gastropod and one insect. Seasonal restrictions on construction would protect nesting success for the ferruginous and Swainson's hawks. The timing of construction and the temporary nature of construction disturbance (pipeline construction averages two miles per day) would minimize impacts to the white-faced ibis, mountain plover, or long-billed curlew using the area.

Allen's 13-lined ground squirrel may no longer exist, largely due to the use of poisoned grain (Clark and Stromberg, 1987). If it is still present in the Bighorn Basin, construction of the Elk Basin Trunk Pipeline, Beaver Creek Alternative and Little Buffalo Basin Spur Pipeline could cause mortality among individuals with burrows on the right-of-way.

The narrow-footed hygrotus diving beetle has been reported in drainages to be crossed or near to portions of the Salt Creek Project and Frontier/ Casper Alternative pipelines (BLM, 1985a). Timing of construction is such that the intermittent and ephemeral drainages should be crossed during times of no surface water, minimizing potential impacts. Any ephemeral pools present in the construction zone could support the diving beetle and would be avoided where possible during construction. Adults, capable of flying, could escape affected pools but any juveniles would be destroyed. Since the reproductive habits of the beetle are prolific, loss of one season of juveniles should not be a serious impact on the population.

4.6.2 Fontenelle Project

Areas of crucial winter range for moose, deer and antelope exist along the proposed gas gathering system right-of-way. Approximately 50 and 55 acres of deer and antelope, and moose crucial winter range would be disturbed respectively during the pipeline construction. Disturbance of these crucial ranges would be short-term and would not be allowed during the no surface occupancy periods for these species. During construction of the Green River pipeline crossing, Amoco would minimize any disturbance to riparian vegetation to reduce impacts to important winter moose forage in this area. The crossing would be located adjacent to an existing pipeline crossing in order to minimize disturbance of natural areas. Crucial moose winter range extends along the Green River and should be adequate to compensate for

any short-term loss in forage at the pipeline crossing. The existing crucial winter range for deer and antelope in the area is extensive and should easily accommodate the short-term forage loss of 50 acres.

The pipeline and plant site would disturb approximately 20 and 40 acres of sage grouse nesting and rearing habitat, respectively. Since each sage grouse lek is associated with approximately 8,000 acres of nesting and rearing habitat, the 20 acres of short-term and 40 acres of long-term disturbance should be insignificant. The lek for this nesting/rearing area is 1 mile from the pipeline route and 1.5 miles from the plant site. Since it is located on a mesa above the project facilities, it is unlikely that the plant site contributes significantly to the nesting and rearing habitat of the sage grouse population associated with the lek.

There are no crucial big game ranges, known raptor nests or prairie dog concentration areas near the plant site. Therefore, there will be no impacts to these important habitats from construction of the plant.

Within the Raptor wellfield there are approximately 800 acres of moose and 1,970 acres of deer and antelope crucial winter range. Development of this field will be associated with approximately 192 acres of long-term and 263 acres of short-term disturbance (Table 4-15). This disturbance will take place within the approximate 20,000-acre wellfield. Since the locations of wells and roads is not currently known, the total disturbance of *crucial habitat* cannot be estimated. Significant impacts to these species could occur if most of the disturbance were to occur in these crucial habitats, although there are also adjoining crucial winter moose, deer and antelope ranges outside the wellfield. During development of the wellfield, new roads and wells should be sited, to the extent possible, to avoid crucial ranges.

No sage grouse nesting or rearing areas or prairie dog concentration areas are known to exist within the wellfield. Therefore impacts to these habitats should be insignificant. Since a sighting of a black-footed ferret was confirmed approximately two miles west of the wellfield, surveys should be conducted for prairie dog towns and associated black-footed ferrets before any construction. Surveys in the wellfield for active raptor nests near construction areas will determine if impacts would occur from construction and what steps must be taken to protect raptors. The whooping crane area along Fontenelle Creek is northwest of the Raptor Field. Wellfield activities west of the reservoir would be minimal (estimated at one well) and should not affect the crane area.

Resident brown trout and migrating kokanee salmon spawn in the general vicinity of the Green River crossing. Selection of the river crossing adjacent to other recent disturbance and timing of construction to take advantage of low water but to be accomplished prior to spawning would minimize disturbance to spawning or to eggs or larvae in the sediment. If impacts should occur, e.g., if spawning gravels are covered with sediment from upstream construction, the impacts would be limited to one season and affect only one year class. Because of the drawdown of Fontenelle Reservoir for dam repair, the habitat is presently of lessened value.

The pipeline for the Fontenelle Project is unique among the proposed projects in that it would carry hydrogen sulfide, a gas. A pipeline rupture or slow leak would have the impacts of a CO_2 pipeline rupture, as described in the introduction, but would have the additional impact of a poison being released into the river. Most of the escaping gas would be vented to the atmosphere in the erupting plume of gas, water and overlying sediment that would accom-

pany a rupture. Fish in the immediate vicinity of the rupture would be killed.

Block valves, whose closure will quickly limit the amount of gas entering the river, will be placed on both sides of the Green River. The waters of the Green River would quickly dilute the dissolved gas and oxidation to non-toxic products would occur.

In the event of a sour gas well blowout or sour gas pipeline rupture, mammals in the vicinity would probably be killed. The BLM (1893c) estimated that death to humans could occur between 0.25 and 0.5 miles of a well blowout. And, for a pipeline rupture, death could occur up to four miles away. These distances are highly dependent on the type of rupture and the meteorological conditions at the time of the rupture or blowout. If any release of sour gas occurred and impacted wildlife, Amoco would reimburse the Wyoming Game and Fish Department for any losses.

4.6.3 Elk Basin Project

Eight areas of deer and antelope crucial winter range would be crossed by the pipeline and short-term disturbance of these ranges would be approximately 437 acres. Four block valves, each occupying 0.1 acre, would be placed in crucial winter range. These 0.1-acre areas would be lost to wildlife use over the long-term. Due to their small size in a large area, this would not be a significant impact.

Sage grouse nesting and rearing habitats exist in 5 locations associated with 17 leks along the pipeline. A total of 264 acres of nesting and rearing habitat could be disturbed during construction of the pipeline. The total nesting and rearing habitat for these five areas is over 60,000 acres. Therefore a significant impact to sage grouse is not expected. Construction would also be avoided during nesting periods between February 1 and July 31 and all leks would be avoided to minimize impacts to sage grouse.

Eighteen raptor nests are close enough to the right-of-way such that nesting raptors might be disturbed by construction activities. Impacts to raptors should be insignificant, however, since no nests would be damaged and seasonal restrictions would be observed for active nests.

Four known prairie dog concentration areas will be crossed by the pipeline with disturbance estimated at 25 acres. Thirteen other concentration areas are also known adjacent to the pipeline route. Surveys for black-footed ferrets would be conducted before construction begins to ensure this *endangered species* does not exist in areas of disturbance.

Crossing of the Shoshone, Greybull and Bighorn Rivers would occur near existing corridors. Disturbance of riparian vegetation would be minimized with effective implementation of the impact control measures described in Appendix 1. The Bighorn River crossing has been revegetated with riparian species since the last disturbance, and some mature riparian vegetation would be removed.

Stream crossings at low water but prior to October 1 would minimize potential impacts to spawning trout. Crossing of any of the three rivers could take more than eight hours or more than one day causing stress to fish in the area. Effects of a pipeline rupture in any of the perennial streams of the Elk Basin Trunk Pipeline are described in the introduction.

There are no crucial big game winter ranges or prairie dog concentration areas in the vicinity of the plant site, therefore, construction of the plant will not impact these habitats. One golden eagle nest and two sage grouse nesting/rearing areas are known near the plant site. The area

of the plant is in the same area as the existing Elk Basin gas plant; consequently, construction would be in a heavy industrial use area and should minimize disturbance to these species. Also, the 40 acres of long-term disturbance associated with the plant site would be in an area of over 20,000 acres of sage grouse nesting and rearing habitat which should prevent significant impacts to sage grouse.

Big game would not be impacted from wellfield activities in the Elk Basin field since no crucial ranges exist in this field. Two prairie dog concentration areas are mapped near the boundary of the wellfield. If these are to be impacted by wellfield activities, they would be surveyed to see if black-footed ferrets exist in these concentration areas. Impacts to golden eagles within the field are not expected to be significant because construction near nests would be restricted during the nesting period. The proximity of wellfield disturbance to active nests is presently not known. However wellfield construction activities would be planned to avoid all nests. Seasonal restrictions do not apply to operation of wells.

About 665 acres of short-term disturbance is expected within the approximate 8,500 acres of wellfield for replacement of production and injection pipelines. The effect of this disturbance on sage grouse would depend on the exact location of disturbance in relation to nesting/rearing habitats. All lek areas would be avoided and seasonal restrictions for surface occupancy in nesting and rearing areas would be observed. There are approximately 8,000 acres of nesting and rearing area within the field and another 20,000 adjacent to the wellfield which should provide habitat for any birds displaced by construction.

4.6.4 Beaver Creek Project

The pipeline would disturb 155 acres of deer and antelope crucial range. This range is extensive and runs for approximately 17 miles along the pipeline. Impacts should be insignificant to these animals because of the short-term nature of the disturbance, the amount of existing crucial range available and the seasonal restrictions which will be applied to construction in this range. One block valve occupying 0.1 acre would likely be placed within a large big game crucial winter range, between mileposts 21 and 39. This would not be a significant impact, given the relative sizes of the disturbance and the area.

The pipeline would also disturb 32 acres of sage grouse nesting habitat. If construction is restricted to non-nesting periods sage grouse should not be affected by pipeline construction since there is approximately 8,000 acres of nesting habitat available. Because no raptor or prairie dog concentration areas are known to exist on the right-of-way impacts are not expected to be significant.

The pipeline would cross the Sweetwater River near an existing pipeline crossing, and impacts to riparian vegetation would not be significant. Potential impacts to spawning trout in Crooks Creek and Sweetwater River would be minimized by completion of construction before October 1, at low water but before spawning activity. Crossing of the Sweetwater River could take more than eight hours or more than one day, violating the significance criterion on time of in-stream activity.

The plant site and wellfield are in crucial winter range for antelope. The plant site would occupy 40 acres of crucial range for a long-term period. Wellfield activities associated with installing the CO_2 injection system in the wellfield will disturb approximately 228 acres for a short-term period. There are

approximately 11,000 acres of crucial winter range within the 17,000-acre wellfield and this range extends outside the wellfield. Impacts to antelope from either the plant construction or wellfield activities should be insignificant since most disturbance would be short-term, there are extensive areas of crucial range in the area and construction activities will be restricted during crucial periods.

There are no known sage grouse nesting or rearing areas or prairie dog concentration in the plant site or wellfield areas; therefore impacts to these habitats would be insignificant.

4.6.5 Little Buffalo Basin Project

While there are several crucial winter range areas in the vicinity of the spur pipeline, only about 36 acres would be affected. The spur pipeline would, however, intersect five sage grouse nesting/rearing areas for a total disturbance of 174 acres. One ferruginous hawk nest on the pipeline route would require the protection of seasonal construction restrictions.

The proposed plant site would not impact any crucial winter range but is within sage grouse nesting/rearing habitat. The plant site would remove 40 acres of the lek's 8,000 acres of habitat for the life of the project. Depending on the location of wellfield construction, a total of 819 acres of sage grouse habitat could be impacted in six nesting/rearing areas. While the plant and wellfield construction would be in an existing oil field, the impact on sage grouse could be significant if all disturbance is simultaneous. However, formulating a field development plan which optimizes pipeline corridors would reduce disturbance and minimize impacts to sage grouse.

4.6.6 Salt Creek Project

No impacts to wildlife would be expected with the Salt Creek Project. Construction of the plant in an old, existing field and the relatively short length of the proposed pipeline would minimize the potential for adverse effects.

Associated Projects. The Bairoil/Dakota Pipeline would affect about 120 acres of antelope crucial winter range and about 24 acres of sage grouse nesting/rearing habitat.

4.6.7 Beaver Creek Alternative

The Beaver Creek Alternative alignment section would have very little impact on wildlife. It would affect about 30 acres of antelope crucial winter range and about 73 acres of deer and antelope crucial range. No raptor nests or sage grouse nesting/rearing habitat would be affected. Only one prairie dog area is within 0.5 miles of the pipeline route. Bridger Creek does not contain spawning habitat in the area of the stream crossing.

This alternative alignment would also impact the wildlife resources described for the Beaver Creek Trunk Pipeline and for the Elk Basin Trunk Pipeline from mileposts 0 to 132 (see Tables 3-15 through 3-18).

4.6.8 Frontier/Casper Alternative

No crucial winter range would be affected by this pipeline alternative. Three areas of sage grouse nesting/rearing habitat totaling about 75 acres would be crossed by the Frontier Access Section alignment and one would be crossed by the Casper Section. Since this habitat would not be disturbed during its normal season of use and because it is a small percentage of total available habitat, this impact should not

be significant to the sage grouse population. In the Frontier Access Section, most of the raptor nest sites mapped for the area are along the Green River, and the right-of-way is outside of the designated buffer areas for these nests. Casper Section nests are also far enough from the right-of-way to avoid impacts.

Several prairie dog towns are known in the area and they would be surveyed for black-footed ferrets before construction.

Casper Creek, a Class 4 trout stream with rainbow trout, is the only perennial stream crossed by either section of this alignment. Crossing would occur after the spawning season, and would not be expected to have significant effects. As with the Salt Creek Project, this Alternative crosses intermittent drainages within or near the habitat of the narrow-footed hygrotus diving beetle, one of the sensitive species noted.

4.6.9 Exxon Alternative CO_2 Supply

The Exxon feed gas trunkline would impact about 250 acres of crucial deer and antelope winter range, 50 acres of elk crucial winter range and about 18 acres of crucial moose range. While the trunkline would not be constructed during the crucial winter season, construction will reduce forage and cover currently provided by the right-of-way vegetation. These impacts are considered short-term and would probably not significantly impact the herds since additional crucial range is available for all of these species adjacent to the areas to be disturbed.

The feed gas trunkline would impact about 32 acres of sage grouse nesting/rearing habitat from a lek about 0.75 miles from the pipeline route. There is only one golden eagle nest that could be affected by the trunkline construction. Seasonal construction restrictions would apply to these species' habitat and to construction in about 2.5 miles of whooping crane habitat west of Fontenelle Reservoir.

Several prairie dog towns along the trunkline route would be surveyed before construction to assure that no impacts could occur to the black-footed ferret.

No crucial winter ranges, sage grouse leks, raptor nests or prairie dog towns would be affected at the Phase II Shute Creek Plant site.

An estimated 736 acres of short-term disturbance and 376 acres of long-term disturbance is estimated for the wellfield. The amount of this disturbance which would occur in crucial winter habitat cannot be determined. Similarly, the severity of impacts on the sage grouse habitat and raptor nests listed in Tables 3-17 and 3-18 cannot be estimated without knowing the location of well sites. Only one prairie dog concentration area is mapped for the wellfield. This and any new towns located would be surveyed for black-footed ferrets before construction.

Potential impacts of sour gas well blowouts and pipeline ruptures would be similar to those described for the Fontenelle project. The concentration of H_2S would, however, be higher for the Exxon project. The Exxon project would not, however, impact the Green River or Seedskadee National Wildlife Refuge.

4.6.10 No Action Alternative

Implementation of the No Action Alternative would not impact wildlife resources.

4.7 AIR QUALITY

4.7.1 Introduction

Impacts to air quality were evaluated against the primary and secondary *National Ambient Air Quality Standards (NAAQS)*, *Wyoming Ambient Air Quality Standards (WAAQS)*, and the *Prevention of Significant Deterioration (PSD)* regulations. These standards are provided in Table 3-19. Primary standards are designed to protect public health, while secondary standards are designed to protect public welfare (BLM, 1983d). Public welfare includes the effects pollutants would have on soils, water, vegetation, wildlife, weather, damage to property and personal comfort.

Annual average standards are never to be exceeded. Short-term standards, 24 hours or less, generally cannot be exceeded more than once per year. The Wyoming half-hour H_2S standards of 70 ug/m^3 and 40 ug/m^3 are not to be exceeded more than twice per year, and more than twice in any five consecutive days, respectively.

Areas currently in compliance with NAAQS and WAAQS are classified as Attainment areas while areas which are not in compliance are classified as Non-attainment areas. All the Proposed Action projects and alternatives would be constructed in Attainment areas and increased *emission* from the projects must be in compliance with the Prevention of Significant Deterioration (PSD) regulations. Allowable increments in pollutant concentrations for PSD areas are given in Table 3-19.

Short-term impacts to air quality from construction of the proposed projects and their alternatives would include increases in wind-borne or *fugitive dust* from construction activities and wind erosion from disturbed areas. Emissions of small amounts of pollutants such as nitrogen oxides and hydrocarbons from construction equipment and additional vehicles transporting workers would also occur. The BLM (1985a) estimated that for the Bairoil CO_2 Project, about 8 tons of fugitive dust could be created for each mile of pipeline constructed. This amount would be insignificant on a regional scale (BLM, 1985a). Other construction-related impacts should also be insignificant because the construction period in any location is very short and because construction will be spread over a large geographic area. Unavoidable fugitive dust from construction usually has plumes that exhibit low emission heights, are non-buoyant, and have large-size particles that settle out quickly.

Short-term construction impacts would be reduced once construction activities have ceased and after disturbed areas are reclaimed. During project construction fugitive dust can be reduced by watering problem areas and limiting clearing of vegetation from the right-of-way and other disturbance and restricting vehicle travel where practical.

Emissions from the CO_2 recycle plants would generally reduce total overall emissions at the existing fields by reducing H_2S and SO_2 emissions. Reduced emissions would improve the existing air quality conditions, and therefore cumulative beneficial impacts from the Proposed Actions will be realized.

Cumulative impacts from construction activities, when considering all of the Proposed Actions together, would be insignificant since the projects would be phased and are spread over a large geographic area.

4.7.2 Fontenelle Project

The Fontenelle Plant would sweeten sour gas produced in the Raptor CO_2 Field. Acid gas produced in the sweetening process would be injected into the Madison Formation. Underground injection of the acid gas would eliminate the potential for SO_2 emissions for the proposed Fontenelle

Plant. Amoco could not at this time use a tail-gas cleanup system for the gas since significant emission would not be allowed in the area. Exxon's Shute Creek Plant presently has 96 percent of the SO_2 increment in the project area. If Exxon does not begin Phase II construction by September 1989, their air permit would expire. Amoco could, at that time, apply for the increment available in order to utilize a tail-gas cleanup system.

The Fontenelle Plant would produce emissions of NO_x, CO, VOC and *particulate* matter. Estimated background levels and maximum measured short-term levels of these pollutants within the Fontenelle study area are well below NAAQS and WAAQS requirements. Estimated emissions from the Fontenelle Plant are not available since preliminary design of the plant has not been completed. However, all emissions would comply with NAAQS, WAAQS and PSD requirements and would be permitted by the WDEQ--Air Quality Division.

The BLM (1983d) studied acid deposition in the PSD Class I Jim Bridger Wilderness Area for the Riley Ridge Natural Gas Project EIS. The EIS concluded that the Riley Ridge Natural Gas development would have insignificant impacts to the Class I areas within the wilderness due to acid deposition. The proposed Fontenelle Project is within the study area of the Riley Ridge EIS. Estimated emissions from the Fontenelle Project would be substantially lower than what is produced from the Exxon's Shute Creek Plant and therefore the Fontenelle Project is expected to have insignificant impacts to this Class I area.

4.7.3 Elk Basin, Beaver Creek and Little Buffalo Basin Projects

CO_2 recycling plants at these fields would generally reduce the overall existing field emissions. Although increased emissions of NO_x, CO, VOC and particulate matter would occur, SO_2 and H_2S emissions would be significantly reduced. The LO-CAT units, which would be installed at the four fields, would reduce H_2S presently being flared or otherwise released from the fields, which in turn would lower total sulfur emissions. Table 2-7 provides an analysis of composition of the LO-CAT off-gas from the Bairoil Recycle Plant. Total H_2S emissions from the LO-CAT unit is estimated at less than 200 pounds per year in concentration of 5 to 6 *ppm*. According to the BLM (1985a), SO_2 emissions were reduced from 509 tons per year to 45 tons per year in the Bairoil Field by construction of a CO_2 recycling plant and upgrading of existing facilities for CO_2 injection. Estimates of emissions from the Beaver Creek, Elk Basin and Little Buffalo Basin projects are not available. However, all emissions would comply with WAAQS and NAAQS and would be permitted through the WDEQ--Air Quality Division.

4.7.4 Salt Creek Project

Existing emissions of SO_2 from the Salt Creek Field would not be reduced as significantly as at the other fields. A new gas production plant, to be constructed in 1988 and prior to the CO_2 recycling plant, will significantly reduce SO_2 emissions by an estimated 400-600 tons per year (Calder, 1988). Emissions data available for a CO_2 recycling plant similar to the proposed Salt Creek Plant (estimates provided in Table 2-7) indicate the Proposed Action recycle plant would not significantly improve or further degrade the air quality in the area.

4.7.5 Beaver Creek and Frontier/Casper Alternatives

Implementation of these pipeline alternatives would still require the installation of the Proposed Action recycle plants. No significant impact differences to air resources would be expected by implementing these alternatives.

4.7.6 Exxon Alternative CO_2 Supply

Implementation of the Exxon Alternative Supply would result in significantly more emissions than if Amoco constructed the Fontenelle Project. However, the increased emissions from Phase II of the Shute Creek Plant would comply with the NAAQS and WAAQS.

The reasons for the larger emissions from the Shute Creek Plant are threefold. First, the Shute Creek Plant, expanded to full capacity with Phase II, would be capable of processing nearly 10 times as much inlet gas as Amoco's Fontenelle Project. Second, gas produced from the Riley Ridge Field contains significantly more H_2S (4.5 percent), which is approximately 4 times higher than gas produced from the Raptor Field (1.15 percent). Finally, although tail-gas cleanup at the Shute Creek Plant is very efficient, some sulfur compounds are still released to the atmosphere. Amoco's initial design, however, would result in the reinjection of the acid gas waste stream to the Madison Formation during routine operations.

The major difference in emissions between the two projects is based on the total amount of sulfur dioxide released to the atmosphere. Under the reinjection scenario presently proposed by Amoco, operation of the Fontenelle Plant would result in essentially no emissions of SO_2. Operation of Phase II of the Shute Creek Plant would increase SO_2 emissions from Phase I by 2,677.8 tons per year.

4.7.7 No Action Alternative

No change in existing emissions would result from implementation of the No Action Alternative. However, flooding the existing Elk Basin, Beaver Creek and Little Buffalo Basin fields with CO_2 will provide an opportunity to significantly reduce emissions of H_2S and SO_2 from these fields, as field gas presently released to the atmosphere would be piped to the recycle plant under the Proposed Actions.

4.8 CULTURAL RESOURCES

The Advisory Council on Historic Preservation has developed guidelines for determining adverse impacts for any site on or eligible for nomination to the National Register of Historic Places. Adverse impacts consist of:

1. Destruction or alteration of all or part of a property;
2. Isolation from or alteration of its surrounding environment;
3. Introduction of visual, audible or atmospheric elements that are out of character with the property or alter its setting.

These adverse effects can be in the form of direct, indirect or cumulative impacts. Direct impacts are physical in nature and adversely affect the site or its setting. Construction activities would be the primary direct impact affecting eligible sites or structures. Indirect effects would not immediately result in physical alternation of the site or its setting. Improperly blocked access along the right-of-way would allow public access and exposure of the properties. Eventual

artifact collection or vandalism would physically alter the site.

Ability to gauge the effects of any project on cultural resources depends on the availability of information from surveys and the extent of the project area that has had surveys. As indicated in Section 3.8, data for large portions of the Proposed Actions and alternative study areas is either lacking entirely or inadequately documented to determine potential impacts on cultural resources. If rights-of-way are to be approved, a Class III cultural survey and appropriate mitigation (which may include avoidance) of eligible sites must be performed before final approval is granted.

Recent experience with the Bairoil CO_2 Project has demonstrated that even with a pedestrian survey (Class III) and testing, it is difficult to accurately evaluate the potential for disturbing buried cultural resources until the pipeline trench is opened. It is important, therefore, to have an effective mitigation plan developed and approved prior to the start of construction to avoid loss of important cultural information and adverse impacts on listed or eligible sites.

There are a wide range of mitigation measures which may be considered. These include, but are not limited to:

- Modifying the proposed action to avoid the significant site;
- Maintaining, preserving, or restoring the impacted site;
- Conducting detailed recording of structures or features prior to their impact; and
- Conducting data recovery activities, such as archaeological excavation.

Not all significant sites have the same research value and, therefore, they will be treated in an individual manner. Eligibility to the *NRHP* suggests, but does not define, how a cultural property should be treated. It may be necessary to conduct an archaeological testing program at individual sites to formulate a mitigation program which takes into consideration the importance of the data these particular resources contain.

Historic trails are a special category of historic resource that is vulnerable to destruction or alteration. Road grading directly eliminates most evidence of their location, whereas traffic by modern vehicles, especially four-wheel drives can severely deform or damage the remaining evidence of 100-year-old trails.

Known historic trails would be crossed by all pipelines except for the Little Buffalo Basin Pipeline (see Section 3.8). Impacts would vary depending on existing conditions of portions that would be crossed. Since the conditions at many of the crossings is unknown, a Class III survey would be conducted on all crossings to formulate site-specific treatment or mitigation plans.

For adequately surveyed and recorded areas with sites considered ineligible for the NRHP, no further work is recommended. For known sites that have not been sufficiently evaluated, evaluation should be made if there is potential for the project to either physically disturb the site or affect its setting. A Memorandum of Understanding (MOA) and a Roles and Procedures addendum detail specific avoidance and mitigation procedures for the projects has been developed through negotiations between BLM and the State Historic Preservation Offices, Advisory Council on Historic Preservation and Amoco (see Appendix 3). Implementation of that MOU will assure that cultural resources are adequately protected during all aspects of project construction and operation. In essence, strict adherence to the MOA will eliminate the possibility of significant impacts to cultural sites.

4.9 MINERAL AND PALEONTOLOGICAL RESOURCES

4.9.1 Introduction

Pipelines can affect the recovery of mineral resources in an area where prior mineral rights have not been established and mineral extraction equipment would be forced to work around pipes or avoid the pipeline right-of-way. Where the Proposed Action or alternative pipeline routes would be constructed adjacent to existing rights-of-way or in designated corridors, the development potential of mineral resources would have already been impacted. Addition of another pipeline would not essentially change the potential for recovering the mineral resource. If the resource is already leased (e.g., coal) or under valid claim (e.g., uranium), issuance of a right-of-way would not impact the potential for development of the resource since the mineral resource would have a prior right. In the latter case, Amoco would be responsible for moving the pipeline to permit mineral extraction at a later date.

Since an adjustment of 75 feet would not be critical for placement of wells for oil and gas development, the rights-of-way should not adversely affect oil and gas development. The presence of a CO_2 source near in the Big Horn Basin and other project areas (i.e., via the Proposed Action spur and trunk pipelines) may have a positive impact on oil recovery in the future. Many fields in the vicinity of spur and trunk pipelines, other than those considered in this DEIS, are likely candidates for future *enhanced oil recovery*.

Construction activities, such as trenching, are often responsible for the discovery of paleontological resources. In accordance with the BLM's standard stipulation for surface-disturbing actions in strata with a high potential for paleontological resources (BLM, 1986b; BLM, 1986e), highly sensitive areas would be monitored during construction by a qualified paleontologist with a permit issued by the Wyoming State Office of the BLM. Should significant *fossil* resources be encountered along any of the pipeline routes, in the wellfields or plant sites, construction activities would be terminated until the resource could be evaluated and any necessary mitigation measures developed and implemented. The cost of any mitigation measures would be the responsibility of Amoco. Thus, while pipeline construction may destroy some paleontological resources, no significant impacts are expected with implementation of the required monitoring and mitigation. In fact, the opportunity exists for the discovery of important paleontological resources during construction of the Proposed Actions and their alternatives.

4.9.2 Fontenelle Project

While the proposed project would traverse an area of high potential for oil and gas development, it would not be constructed in areas presently being mined for coal, *trona*, uranium or oil shale, and therefore would not result in significant impacts to mineral resources.

The gas gathering system would cross approximately five miles of the Laney Member of the Green River Formation and approximately nine miles of the Bridger Formation, both of which have a high paleontological sensitivity (Table 4-24). Both of these formations have yielded significant fossil resources. East of Fontenelle Reservoir, the right-of-way would closely border the contact between the Green River Formation and an area of dune sand and *loess*, which has a low sensitivity rating. Field checking of the staked right-of-way should verify the geologic formation to determine whether monitoring is required.

4.9.3 Elk Basin Project

While the proposed Elk Basin Trunk Pipeline would be constructed in both the Big Horn and Wind River coal basins, it would not traverse any areas of known thick or abundant coal. If the bentonite claims in the South Bighorns Resource Management Unit are valid, these claims would have prior rights and the pipeline would not preclude development. If they are not valid, the pipeline could affect their future development potential.

Approximately 60 percent of the proposed Elk Basin Trunk Pipeline would cross geologic formations with a high paleontological sensitivity (Table 4-24). The proposed right-of-way segments between mileposts 50 and 76 and between mileposts 130 to 157 are of particular paleontological interest. With adherence to required trench monitoring in these areas and development of adequate mitigation measures should a significant discovery be made, the pipeline should not have a significant impact on paleontological resources.

4.9.4 Beaver Creek Project

The proposed Beaver Creek Trunk Pipeline would be constructed in an area of moderate to high oil and gas potential. Development of these resources may benefit from proximity to the CO_2 pipeline in the future. South of Sand Draw and to the west of Jeffrey City (mileposts 23 through 29), the pipeline would cross a "mineralized area," where isolated pockets of rubies, sapphires and jade occur, but these gems are not considered to be economically significant mineral resources in this area.

Where the proposed pipeline would cross the Crooks Gap - Green Mountain Uranium District (mileposts 38 through 45), uranium claims have prior rights and their development would not be precluded. If a pipeline right-of-way is granted in this area, Amoco's proposed alignment adjacent to an existing pipeline through this area would probably cause the least conflicts with future uranium development.

The White River, Wagon Bed and Wind River formations, all with a high paleontological sensitivity rating, would be crossed by the proposed pipeline (Table 4-24). The Miocene-age strata in this area have a moderate to high sensitivity. The areas traversed are considered to have a high sensitivity and the pipeline trench through this area would be monitored. With adequate monitoring and mitigation, the impacts on paleontological resources should not be significant.

4.9.5 Little Buffalo Basin Project

While the proposed pipeline would be constructed through the Bighorn Coal Basin, it would not cross areas of known thick or abundant coal. Any impacts to coal development should, therefore, be minor. Oil recovery in the fields near the Little Buffalo Basin Pipeline may benefit from presence of the CO_2 pipeline.

Approximately 80 percent of the pipeline would cross geologic formations with a high paleontological sensitivity (Table 4-24). While the first four miles of the right-of-way traverse gravel, pediment and fan deposits (rated low in sensitivity), the BLM has recorded fossil resources in the area (BLM, Worland District, file data). The route of the proposed pipeline closely follows the contact between low-sensitivity deposits and the Willwood Formation (high sensitivity). Should this portion prove to be in a high-sensitivity formation when the route is field-checked, the trench would also be monitored.

Table 4-24. Miles of Paleontologically Sensitive Formations Crossed by the Proposed Projects.

	Number of Miles				
	High	Mod-High	Moderate	Low	Total Miles
Fontenelle	16.0	--	--	6.5	22.5
Elk Basin	112.0	--	29.0	37.0	178.0
Beaver Creek	14.0	23.5	3.0	3.5	44.0
Little Buffalo Basin	29.0	--	4.0	3.0	36.0
Salt Creek	--	--	9.0	--	9.0
Beaver Creek Alternative	53.0			2.0	55.0
Frontier/Casper Alternative					
Frontier Section	24.0	--	--	--	24.0
Casper Section	16.0	--	17.5	6.0	39.5

4.9.6 Salt Creek Project

In addition to the Salt Creek Field, the Salt Creek Spur Pipeline would be constructed in an area of high potential for oil and gas development. After flooding of the Salt Creek Field, other oil fields in the area may benefit from the availability of CO_2. The pipeline would not cross any areas of coal or salable minerals (BLM, 1984a).

Cody Shale is the only geologic formation that would be crossed by the proposed pipeline. This formation has a moderate sensitivity for paleontological resources (Table 4-24) and would not require monitoring.

4.9.7 Beaver Creek Alternative

The Beaver Creek Alternative would be constructed in both a known geologic structure (KGS) and an area with high potential for oil and gas development. Future oil recovery may benefit from presence of the pipeline in the area.

Coal is also present in the project area, but there are no active coal mines in the vicinity. The pipeline would cross approximately 15 miles of the Copper Mountain Uranium District, but uranium mining has continued to decrease in the area (BLM, 1986b). As described above, valid existing claims would not be precluded from development with issuance of the right-of-way.

All but 4.5 miles of the 55-mile pipeline would traverse the Wind River Formation, which has a high paleontological sensitivity (Table 4-24) and would require trench monitoring and possibly mitigation to maintain impacts on paleontological resources at an acceptable level. Small areas of alluvium and colluvium, with a low sensitivity, occur in drainages along the pipeline.

4.9.8 Frontier/Casper Alternative

The Frontier Access Section would traverse an area of high potential for oil and gas development. Since a CO_2 source already exists in this area (i.e., the Rangely and Bairoil/Dakota pipelines), the Frontier Access Section should have neither a positive nor a negative impact on future enhanced oil recovery.

The section would not be constructed in areas presently being mined for coal, uranium or oil shale. All trona mining operations are over five miles from the right-of-way. The Casper Section would not traverse any areas of economically minable coal.

All 24 miles of the Frontier Section would cross the Bridger Formation, considered to have a high paleontological sensitivity. An area of significant paleontological resources was of concern during construction of the Rangely CO_2 Pipeline (BLM, 1984b), but this area is at the Red Creek Escarpment, over 25 miles southeast of the alternative pipeline location. Approximately 60 percent of the Casper Section would cross geologic formations with a high paleontological sensitivity which would require trench monitoring (Table 4-24).

4.9.9 Exxon Alternative CO_2 Supply

Construction of Phase II of the LaBarge Project would occur in areas already intensely developed for oil and gas resources. The feed gas trunkline from the Riley Ridge Field to the Shute Creek Plant site would be constructed in an existing feed gas trunkline right-of-way. Phase II of the plant would be constructed adjacent to the existing plant site and additional development wells would be drilled in the Riley Ridge Field.

If Exxon decides to construct Phase II of the LaBarge Project, a significant source of CO_2 would become available for enhanced oil recovery throughout the Powder River Basin of Wyoming, southeastern Montana and the Williston Basin of North Dakota. If Amoco constructs the Fontenelle Project, only enough incremental CO_2 would be available to flood the Proposed Actions discussed in this DEIS. If Exxon constructs the full Phase II project (1.3 BSCFD of inlet capacity) and the remainder of the Bairoil/ Dakota Pipeline, additional CO_2 would be available for other enhanced oil recovery projects (such as the Bell Creek Field recently purchased by Exxon in southeastern Montana). However, expansion of Phase II to just accommodate Amoco's demand would have the same affect as constructing the Fontenelle Project.

The decision to construct the full Phase II project must be made based on economic considerations. With the continued depression in worldwide oil prices, enhanced oil recovery projects by other oil operators are not being aggressively pursued and Exxon has had little success in obtaining CO_2 sales contracts for gas presently being vented from Phase I of the Shute Creek Plant (Bryan, 1987). Construction of the full Phase II project without a significant increase in oil price would result in the continued venting, i.e., wasting, of CO_2 to the atmosphere but at a much higher rate than presently occurring.

4.9.10 No Action Alternative

Implementation of the No Action Alternative would eliminate potential future conflicts between Proposed Action and alternative pipelines and mineral resources, but it would make it impossible to proceed with any of the projects since construction avoiding public lands is impossible in all cases. Without the enhanced oil recovery projects, economic factors would require an earlier abandonment of the Elk Basin, Beaver Creek, Little Buffalo Basin and Salt Creek fields, leaving an estimated 160 million barrels of oil unrecovered.

4.10 VISUAL RESOURCES

4.10.1 Introduction

To protect the visual quality of the landscape, every effort should be made to minimize the impact of project activities. When this is done through careful siting, minimizing land disturbance and repetition of natural elements in project design, even major modifications within Class IV areas are permitted and considered acceptable impacts on the visual resource. Assuming the construction practices described in Chapter 2 are followed, the pipeline projects would meet management objectives for Class IV areas. Impacts to Class III areas would not exceed the standards for that class unless topography or other existing conditions posed construction problems which could not be easily reclaimed or subordinated to the existing landscape.

Plant construction would remove vegetation and introduce major structures to the landscape which would remain for the life of the project. Since the plant sites, including the Fontenelle Plant and all CO_2 recycle plants, would be located in Class IV areas in the vicinity of existing oil fields and/or existing industrial disturbance, these facilities would not contrast with or intrude on the existing landscape.

Wellfield activities would remove vegetation but would not add structures to the landscape, except in the Fontenelle Project's Raptor Field which is discussed below. Disturbance in the fields would be short-term, located in Class IV areas and adjacent to existing disturbance in these developed fields. Wellfield activities would not, therefore, have a significant adverse impact on

visual resources for any of the projects.

Construction of the pipelines would remove vegetation, modify the topography in steep areas and add minor new structures to the landscape. The only proposed structures along the pipeline are the origin station, block valves, cathodic protection systems, scraper launchers and traps and signs marking the right-of-way center line. Construction and reclamation activities would have only short-term impacts. The principal long-term impact would be from the unnatural line of vegetation on the landscape. While reclamation of the right-of-way would restore vegetation, the corridor would likely be visibly different from its surrounding natural landscape for many years.

The adverse visual impact of structures and the corridor would not be significant except in visually sensitive areas. Where the route of the pipeline follows existing corridors, the long-term impact would be minimized because the pipeline would not contrast significantly with the existing corridors. Disturbance along an existing corridor would, however, contribute to the cumulative impacts on the area.

4.10.2 Fontenelle Project

While the wellfield structures would meet management objectives for the Class IV area, existing road disturbance should be used whenever possible to minimize additional visual disturbance. Location of the Fontenelle Plant in a Class IV area adjacent to Exxon's Shute Creek Plant makes visual impact of the plant negligible. There are no Class III areas that would be difficult to reclaim or which would have structures that could not be subordinated to the natural landscape.

In order to avoid significant impact on Class II areas (along the Green River and Fontenelle Reservoir), careful siting of project components would be essential. Potential visual impact near the Green River would be minimized to an acceptable level since the river crossing would be made adjacent to an existing pipeline. The only permanent (life of project) structure in this Class II area would be block valves on either side of the Green River.

Since drilling would be completed in less than a year, the presence of drill rigs would have only a short-term impact on visual resources. The one-acre, unreclaimed drill pads and access roads would, however, remain for the life of the project. In order to minimize impacts, siting of development wells in the Raptor Field should be done to keep them out of the Class II areas and to shield them from view from the reservoir itself and from significant recreation sites in the area.

4.10.3 Elk Basin Project

Visual impacts in all areas of this proposed project would be minimized because the trunk pipeline would follow existing pipelines and designated linear corridors whenever possible. In the visually most sensitive area, a Class II area south of the Bighorn River, the pipeline would be in a designated corridor. Impacts in Class III areas in agricultural valleys (Shoshone and Bighorn River valleys) should be minimal since future cultivation in the pipeline corridor will soon obliterate any remnant of the disturbance.

In the Class III area near Sheep Mountain, the unnatural line of vegetation may attract attention but it is not expected to dominate the view since it would parallel a similar pipeline.

Associated Projects. The most significant visual impacts of this section of the Bairoil/Dakota Pipeline would be in the Class I and II area of the Sweetwater Rocks and

Oregon -Mormon National Pioneer Historic Trail (the Oregon - Mormon Trail). While the pipeline would follow an existing pipeline corridor, this area is considered an important recreational and historic site. The Lander Resource Management Plan (BLM, 1986b) has recognized the importance of this resource by prohibiting future right-of-way grants in this area unless no feasible alternative is available. Impacts could be minimized but not eliminated by strictly limiting blading of the right-of-way and using revegetation techniques that would blur the unnatural vegetation line that will otherwise degrade visual quality.

4.10.4 Beaver Creek Project

Visual impacts in all areas of this project would be minimized because the route follows an existing pipeline corridor and is primarily located in Class IV areas. All three of the Class II areas would be crossed near existing corridors. Visual impacts to the Oregon - Mormon Trail at Ice Slough could be minimized by prohibiting all blading within 0.25 miles of the trail. Special revegetation efforts (e.g., special plantings or seed mixes) could also reduce the long-term evidence of disturbance. This section of the trail has the same prohibitions against granting of rights-of-way as described for the Bairoil/ Dakota Pipeline above.

The Sweetwater River crossing would have only a short-term visual impact because the additional water available would enhance revegetation. The pipeline crossing of the river would not contrast substantially with the existing landscape because of the other corridors.

Visual intrusion in the Beaver Divide area is likely since the area is steep and construction would require disturbance of areas outside the right-of-way (BLM Temporary Use Permits would be required in this area) to create safe working surfaces. Revegetation is likely to be particularly slow in this steep, rocky terrain. The proposed pipeline may not, therefore, meet the management objectives of this Class II area. Intrusion on the landscape would be lessened, to some extent, because the pipeline would parallel an existing pipeline through the area.

4.10.5 Little Buffalo Basin Project

With revegetation, the long-term visual impact of the Little Buffalo Basin Project would be minimal. Since much of the route parallels a road in relatively level agricultural terrain, the pipeline corridor is not expected to dominate the view of the observer in Class III areas. Cultivation of the reclaimed pipeline corridor would also mask the corridor in several places. Since the route would follow existing and abandoned pipeline routes, the proposed pipeline would not contrast significantly with existing conditions.

The right-of-way would not intrude on the Class II badlands area north of Gooseberry Creek because of topography (most of the badlands area is topographically lower than the pipeline corridor) and because the right-of-way would be adjacent to the Gooseberry Creek Road.

4.10.6 Salt Creek Project

Because of the extensive existing disturbance in the Salt Creek Field, the project would have a negligible visual impact in the field. The project's principal impact on visual resources would be where the corridor is visible from Interstate 25. Since the proposed spur pipeline does not follow an existing pipeline corridor in this area, the corridor will contrast substantially with the natural environment along the highway. Because the corridor would cross the

interstate at right angles, however, travelers' views of the corridor would be for a very short time.

Associated Projects. Visual impacts of this section of the Bairoil/Dakota Pipeline should be negligible. The crossing of U.S. 20/26 would be at right angles and not, therefore, a major intrusion on travelers.

4.10.7 Beaver Creek Alternative

No significant long-term impact on visual resources is expected because the area of the alternative alignment is designated Class IV. This alternative route would follow an existing pipeline corridor which in many places blends with its natural surroundings because of successful revegetation.

Additional visual impacts would be those described for the Beaver Creek Trunk Pipeline (primarily crossings of the Oregon - Mormon Trail) and the Elk Basin Trunk Pipeline.

4.10.8 Frontier/Casper Alternative

Because the Frontier Access Section of the proposed corridor would follow an existing pipeline corridor, it would not contrast with the existing landscape. The corridor would be most visible from mileposts 15 to 27 as it parallels State Highway 372 but in this Class IV area the contrast would not violate the management objectives. Visual impact to the Oregon - Mormon Trail could be minimized by prohibiting all blading within 0.25 miles of the trail. Special revegetation efforts (e.g., special plantings or seed mixes) could also reduce the long-term evidence of disturbance.

While the Casper Section is primarily within a Class III area, the disturbance is not likely to draw the attention of observers where it parallels other pipelines and dirt roads (mileposts 0 through 25). Visual impact is likely to be greatest where the pipeline would cross Interstate 25 (milepost 26) and south of this crossing to its intersection with the Frontier Pipeline west of Casper. This section neither parallels an existing pipeline nor is it in a designated corridor.

4.10.9 Exxon Alternative CO_2 Supply

The Shute Creek Plant and feed gas trunkline would have negligible impacts on visual resources because of their location next to other disturbances and because of their Class IV rating. While the wellfield is in a Class III area, the addition of 20 wells is not likely to substantially change the quality of the landscape.

4.10.10 No Action Alternative

Implementation of the No Action Alternative would not affect visual resources.

4.11 RECREATION

4.11.1 Introduction

Construction workers are assumed to participate in recreation activities at the same level as the Bairoil CO_2 Project monitored workforce and recreation patterns of operations workers will be similar to those of other Wyoming residents. In order to minimize construction worker impacts, Amoco would maintain a policy to reduce poaching and littering, and would not permit workers to exceed length-of-stay requirements at public campgrounds or to camp on public lands more than 14 days per location.

In no case will temporary or permanent demand for use of recreation areas or facilities increase by 10

percent or more over baseline conditions because of project-related populations. For each Proposed Action, the immigrant plant and field construction population would be small compared with the baseline population (never exceeding 2 percent). It is unlikely that the construction population would use recreation areas at several times the level of the baseline population. Recreation monitoring for other projects has shown that immigrant population associated with a construction workforce typically participates in outdoor recreation at <u>lower</u> levels than the existing population (Wyoming Recreation Commission, 1987a).

The immigrant operations workforce population is expected to recreate at the same level as the existing county population. Since the permanent workforce and its associated population would be extremely small compared with the county population, no permanent increase in demand is anticipated for use of any recreation area or facility.

None of the projects would have a significant direct or indirect impact on any developed recreation facilities in the wellfield, plant boundaries or pipeline corridor, nor on any area available for dispersed recreation. Since most of the construction would take place in areas already disturbed by oil and gas development or along other existing pipeline rights-of-way, direct impacts to recreation would most likely be minor.

Project construction and operation can affect the quality of a recreational experience by producing noise or odors and by changing local and distant scenery, water quality (particularly for fishing), abundance and quality of wildlife and their habitat, or accessibility of cultural resources. Scenic views from points of interest, historic trails, scenic highways and developed recreation sites (campgrounds, picnic areas, etc.) would be affected both during construction and until revegetation blends the colors and textures of the right-of-way into the surrounding landscape. While revegetation is expected to control erosion and restore productivity in less than five years, vegetation differences of the right-of-way are likely to be evident for many years.

Construction workers may also impact recreation resources by parking overnight and camping or setting up residence in areas, resulting in increased vandalism, littering and requirements for trash collection and cleanup. While Amoco would discourage squatting by employees, they would be unable to control the actions of job seekers. Their policy of hiring through Job Services should help discourage job seekers from lingering in the area.

4.11.2 Fontenelle Project

The drilling of ten development wells and the installation of a gas gathering system near Fontenelle Reservoir would adversely impact the quality of the recreation experience during the construction period. If field systems operate as planned, odor will not be a problem during operation of the field, but for some people, the sights and sounds of an operating wellfield could detract from enjoyment of the area. Areas which concentrate visitors, such as campgrounds, picnic areas and viewpoints, are of special concern. At least some of the pipeline corridor would be visible from the dam overlook parking area, which is approximately 1.5 miles at the closest point.

The general concerns associated with river crossings would be aggravated at the Green River crossing by 1) the presence of hydrogen sulfide in the pipeline and 2) the location of the river crossing in a developed recreation area with a reputation for excellent fishing, upstream of the Seedskadee Wildlife Refuge. The proposed crossing area of the Green

River would be in an existing pipeline corridor. The recreation resource would be degraded by any incident which damaged water quality or the fishery, or which damaged the area's reputation as a prime fishing area.

Dispersed recreation activities most likely to be affected by project components include fishing, sightseeing, picnicking and nature study. In general, all existing recreation in the vicinity of project components would be adversely affected to the degree that the components detract from the semi-natural setting of the reservoir and river.

4.11.3 Elk Basin Project

At the Shoshone River crossing, the major concern of the Wyoming Game and Fish Department is maintenance of fishing access following completion of work (Bott, 1988). Any loss of fishing access would be very short-term (a matter of a few days).

Rafting on the Bighorn River, between Thermopolis and Worland, could be interrupted. Visual impacts to the quality of the rafting experience would be very minor, since rafters would move quickly past the pipeline, and viewing angles at water level are restricted by the river banks.

Construction impacts on recreation in *Wilderness Study Areas* should be very short-term (a few weeks), resulting from construction noise and activities visible from some of the higher elevations. The pipeline right-of-way may be evident from the WSAs for a number of years. Recreation activities most affected would be those most dependent upon a natural environment, such as hiking, horseback riding, snowshoeing and cross-country skiing.

The Elk Basin Trunk Pipeline would follow an existing corridor through Polecat Bench, thereby minimizing damage to the geology and fossil beds which are recreation resources in this proposed *National Natural Landmark*. The trunk pipeline will be adjacent to but would not cross the Hell's Half Acre area.

4.11.4 Beaver Creek Project

Relatively high use intensifies the potential recreation impact at the Oregon - Mormon Trail and Ice Slough crossings. Since the proposed pipeline would parallel another pipeline at the crossings, pipeline construction would be a short-term impact although the additional vegetation disturbance could impair the illusion of the pioneer trail. The right-of-way would probably not be noticed from the Ice Slough historical marker, which is approximately the same elevation as the pipeline. The impact, however, should not be significant since the trunk pipeline would be constructed in an existing pipeline right-of-way in this area.

The proposed pipeline would cross or pass near: Beaver Divide (crosses, mileposts 11 through 15); Cedar Rim (crosses, milepost 15); Government Meadows Draw (3 miles from milepost 15 near Cedar Rim); and Green Mountain (within one mile, mileposts 41 and 42). Impacts should be limited to short-term construction sights and sounds and visibility of the right-of-way adjacent to an existing pipeline. Construction could limit access very briefly.

4.11.5 Little Buffalo Basin Project

Project construction and operation would be unlikely to impact deer and antelope hunting or *ORV* use in the vicinity of the proposed pipeline (Sharp, 1988). Sightseeing from State Highway 431 would be slightly affected by the appearance of the pipeline corridor, with the impact greatest where the pipeline is north of the road, in front of the scenic badlands. Additional impacts on

sightseeing would be construction-related travel delays on State Highway 431 during plant, field and pipeline construction.

4.11.6 Salt Creek Project

Although the project area has not been classified according to the *Recreation Opportunity Spectrum (ROS)*, existing development would probably keep the ROS classification no higher than semiprimitive motorized, and the Proposed Action would not change that.

4.11.7 Beaver Creek Alternative

The Beaver Creek Alternative would have approximately the same population-related recreation impacts as the Beaver Creek Project since the workforce would be the same.

Sights and sounds of construction could impact recreation in Boysen State Park and the right-of-way would be removed from recreational use during construction and revegetation. The scenic quality of the park would also suffer until right-of-way vegetation blended with its surroundings. This alternative alignment follows a pipeline and parallels a railroad track in this area.

This alternative would also add to existing development through the Lysite Badlands, which is proposed as a National Natural Landmark, and was identified by the BLM as an Extensive Management Area (BLM, 1986b).

4.11.8 Frontier/Casper Alternative

This alternative would not change the population-related recreation impacts for the Fontenelle Project or the Salt Creek Project since plant and field construction and operations would not be affected. The Frontier Access Section would pass through the Seedskadee National Wildlife Refuge at mileposts 11 and 13, but would not impact any special features or developed facilities. Short-term construction and revegetation disturbances would be the main concerns. Mitigation for visual impacts should minimize recreation impacts to the Pony Express Route and the Oregon - Mormon Trail. Pipeline construction would not restrict movement along these trails but the aesthetic value of historic trail trekking would be eliminated during construction.

4.11.9 Exxon Alternative CO_2 Supply

Potential impacts to recreation resources from Phase II have been evaluated in the Wyoming Industrial Siting Application (Exxon, 1985). Exxon estimated that the peak construction workforce associated with Phase II may increase overall regional demand for recreation by 13 percent. Due to the long construction period required for Phase II, the additional demand would not be short-term. The majority of that increased use is expected to occur in the Bridger-Teton National Forest. Exxon's projections indicate the increase would occur in dispersed recreational use and at developed sites. The largest increases were predicted in camping, driving for pleasure, hiking, fishing horseback riding and hunting.

Increases in hunting and fishing activities as a result of Phase II were estimated to be approximately 30 percent (Exxon, 1985). Significant increases in the use of Fontenelle Reservoir for recreation were also predicted. It is uncertain, at this time, what mitigation measures Exxon would implement to reduce these significant impacts to recreation resources associated with construction of Phase II of the LaBarge Project.

Exxon further concluded that project-related surface disturbance would not

directly disturb any recreational areas, reduce public access or significantly reduce the recreational land base.

4.11.10 No Action Alternative

The No Action Alternative would not result in impacts to recreation resources.

4.12 WILDERNESS

4.12.1 Introduction

The proposed projects or their alternatives could impact wilderness values if construction, operation or maintenance activities intrude physically on the area or if these activities can be seen or heard from the area.

4.12.2 Fontenelle Project

There will be no effect of construction, operation or maintenance of the project on site characteristics that make areas eligible for wilderness designation because there are no Wilderness Areas or Wilderness Study Areas in the project vicinity.

4.12.3 Elk Basin Project

Any impact on the Red Butte WSA is expected to be short-term. Some construction noise may be audible from western parts of the WSA and construction activities may be visible from some of the higher elevations of the area for a few weeks. Long-term impacts would be minimal because of the existing disturbance along the proposed pipeline route. In addition to the existing pipeline corridor followed by the Elk Basin Trunk Pipeline, the Corral Creek and Reservoir Creek drainages, which the route follows, already have several dirt roads and two-tracks that either parallel or cross the pipeline route. The Elk Basin Pipeline would not be a substantial intrusion into this area.

Any impact on the Sheep Mountain WSA is also expected to be short-term but may be more evident than discussed for Red Butte. Sights and sounds of construction may be evident in the east and north parts of the WSA. The pipeline corridor may be evident from Sheep Mountain for a number of years. Disturbance in this badlands area is likely to be greater than 75-feet wide since cut and fill slopes would be necessary in the steep terrain. Revegetation in the poor soils and badlands topography would probably take longer than in the less harsh environment of the Reservoir/Corral Creek valley. The relatively straight pipeline corridor would also contrast with the eroded topography, although from many vantage points only small sections of the corridor would be visible. Even from a small plane, it is difficult to consistently see the existing pipeline disturbance for any distance.

Impacts could be minimized by limiting disturbance to the extent possible and using erosion control techniques to limit erosion during construction and early revegetation. To some extent the natural irregular erosion processes of the area may help to obliterate evidence of the corridor (BLM, 1987c).

The pipeline construction may be evident from small areas of the northeast part of Cedar Mountain WSA but the sights and sounds would not be significantly different from those constantly evident from the agricultural activities of the adjacent Bighorn River valley. The proposed route would closely follow an existing pipeline so additional intrusion would be minimal.

Associated Projects. The major impacts on the Sweetwater Rocks WSAs are expected to be short-term. Construction noise would be audible and construction activities would be

visible from both WSAs. Even with successful revegetation, the corridor is likely to be visible for many years. Since the pipeline would follow an existing pipeline corridor, this intrusion would not be on a completely natural environment.

Since impacts of the project would be reassessed before any right-of-way were granted for the Bairoil/Dakota Pipeline, routes avoiding the Sweetwater Rocks could be considered at that time.

4.12.4 Beaver Creek, Little Buffalo Basin and Salt Creek Projects and the Frontier/Casper Alternative

There would be no effect of construction, operation or maintenance of these projects or alternative on site characteristics that make areas eligible for wilderness designation.

4.12.5 Beaver Creek Alternative

While the Beaver Creek Alternative alignment section would not impact wilderness resources, this alignment would affect all three WSAs affected by the Elk Basin Trunk Pipeline.

4.12.6 Exxon Alternative CO_2 Supply

It is unlikely that construction of the feed gas trunkline, five miles from the Lake Mountain WSA, would be a major impact on its wilderness values. From this distance, it would also be difficult to discern the difference between one or two pipelines in the same corridor.

The wellfield development could have a direct impact upon the naturalness of the Lake Mountain WSA with wellfield activity in Exxon's Graphite Unit adjacent to and within a portion of the WSA. Any proposed wells, access roads and buried pipelines within the WSA would require individual site-specific environmental assessment to determine the significance of impacts (BLM, 1983c).

4.12.7 No Action Alternative

Implementation of the No Action Alternative would have no impact on wilderness resources.

4.13 TRANSPORTATION NETWORKS

4.13.1 Introduction

Vehicle travel delays of more than ten minutes per hour due to Project Actions would not be expected. State and U.S. highway crossings would be dry bored rather than cut, in conformance with requirements of the Wyoming Highway Department. In addition, individual counties may require boring of paved county road crossings. As such, no traffic delays would occur. On smaller unpaved roadways, the open ditch would interface with traffic. On these roads, delays would occur while the trench is cut across the roadway. Adequate safety precautions, such as posting warning signs and use of flagmen have been proposed by Amoco to assure that such crossings are conducted as safely as possible.

The projected annual traffic increases are not expected to reduce the *Level of Service* to below *Level C* for any of the Proposed Actions. No Proposed Action would add sufficient traffic to significantly raise the average annual daily traffic on any road segment. During the construction season, however, the Level of Service may be lowered for short periods of time at peak traffic flows to and from the construction sites.

The addition of traffic, especially the heavy vehicles (trucks and buses), making regular runs to and

from each plant site would accelerate the deterioration and related maintenance costs of some road segments. Additionally, during construction of the pipelines, Amoco would comply with applicable existing federal, state, county and private requirements developed to protect road networks. Any damage to roadways as a result of construction or operation would be repaired by Amoco.

Accident probability rises with increases in the number of vehicles using a road segment. Accident occurrences are reported as the number of accidents per million vehicle miles. Accident rates throughout the highway segments for all of the Proposed Actions are approximately one accident per million vehicle miles. Use of buses to transport workers to the plant site would significantly minimize the number of vehicles associated with construction. The greatest potential for an increase in accident probability would generally occur very early in the construction period if pipeline workers in personal vehicles are using the same road segments as trucks and buses.

No interference with pipelines or power lines would occur. In those instances where the proposed spur or trunk pipelines must cross a foreign pipeline, careful construction techniques would allow the crossing without an interruption of flow.

4.13.2 Fontenelle Project

Maximum impact to average annual traffic would occur in 1990. Construction activities in the Raptor Field in the first quarter would involve an estimated 75 car/pickup round trips from Green River. Construction of the plant would involve 6 buses, 15 20-ton truck trips and 30 miscellaneous trips per day on State Highway 372. This traffic would increase the volume on State Highway 372, affecting the Level of Service temporarily. State Highway 372 has an accident probability rate below the state average. The potential for increased accidents would be highest in the first quarter of 1990, the time of maximum project-related traffic.

Use of buses to transport workers to and from the plant site would significantly reduce vehicle miles traveled and the number of vehicles on the road. Localized traffic congestion at the bus loading/unloading site in Green River could occur in the morning and evening as workers converge or leave the site in a relatively short period of time. Selection of a staging area away from existing congestion in Green River could minimize this potential impact.

4.13.3 Elk Basin Project

The Elk Basin Pipeline would be built in two simultaneous spreads, one beginning at the plant site and one beginning at the connection with the proposed Bairoil/Dakota Pipeline near Powder River. The spreads would work toward each other, meeting southeast of Worland.

Maximum impact to average annual traffic would occur in the second quarter of 1990 on State Highway 295 north of Powell. At this time vehicles driven by pipeline workers would be using State Highway 295 along with trucks and buses serving the plant site. As pipeline construction progresses, these vehicles would no longer use State Highway 295 north of Powell. When both plant and pipeline construction vehicles use the road, 5 buses, 15 20-ton trucks and 97 car/pickup round-trips would occur on the highway daily.

The projected annual traffic increases from project-related traffic would not be expected to reduce Level of Service. On a temporary basis, particularly when pipeline and plant construction crews are utilizing the same roadway, a reduction in Level of Service in the morning and evening could occur in Powell.

The highways that would be utilized in construction of the Elk Basin Project all have vehicle accident probability rates below the state average. The vehicle accident probability rate would be expected to increase temporarily on highway segments being used by the vehicles moving equipment and personnel to the pipeline segment being constructed. As construction progresses south, at an average of two miles per day, different roadways would be used, defining the temporary nature of the construction vehicles' impacts.

Use of buses to transport workers to and from the plant site would significantly reduce vehicle miles traveled and the number of vehicles on the road, reducing the potential vehicle accident probability. At the staging are in Powell, local traffic congestion could occur in the morning and evening. This congestion would likely be heaviest early in the construction period since local traffic patterns normally adjust to avoid congestion that occurs on a regular, predictable basis.

Construction of the southern spread of the pipeline between Powder River and Worland would not be expected to cause significant effects to transportation. The southern spread is not associated with construction of a recycle plant. Much of the pipeline corridor is approached on county and local roadways, away from major highways and towns. Since the Arminto -Lost Cabin Road is likely to be used for access to the pipeline south of Lost Cabin (milepost 135 to the origin station), project-related traffic is likely to accelerate its deterioration.

4.13.4 Beaver Creek Project

Maximum impact to average annual traffic would occur in 1992. Maximum projected daily loading on State Highway 135 from Riverton to the Beaver Creek Plant site or along the pipeline corridor would be 6 buses, 21 20-ton trucks, and 118 pickup/car round trips. This traffic would increase the volume on State Highway 135, affecting Level of Service. State Highway 135 is not heavily used, and the addition of project-related traffic would not likely reduce the roadway operation to below a level of Service Level C.

The vehicle accident probability on State Highway 135 is low, approximately one-half of the state average. Project-related traffic could increase the vehicle accident probability on State Highway 135, especially very early in pipeline construction when the pipeline construction would occur in the same area as gas plant construction. As pipeline construction moves south, the vehicles used in plant construction and pipeline construction will use State Highway 135 at increasingly different times. The increased use of State Highway 135 by project-related traffic could accelerate roadway deterioration.

Project traffic originating in Riverton must turn left off U.S. 20 onto State Highway 135. U.S. 20 is a four-lane highway at this point, and the separate left turn lane to State Highway 135 is of sufficient length to minimize back-up on U.S. 20. Local traffic congestion around the bus staging area in Riverton would probably be increased in the morning and evening for a short time.

4.13.5 Little Buffalo Basin Project

Maximum impact to average annual traffic would occur in 1993. Projected maximum daily traffic would be 6 buses, 20 20-ton trucks and 86 pickups/cars. Vehicle trips would originate in Worland. The route to the Little Buffalo Basin Field would consist of U.S. 20 south, State Highway 431 west and State Highway 120 north. The pipeline route runs east from the plant site toward Worland generally along State Highway 431. As construction progresses, the pipe-

line construction vehicles (5 20-ton trucks and 56 pickups/cars from the above totals) would travel fewer miles each day. This would eliminate these vehicles' use of State Highway 120 relatively early in the construction period. This traffic overall would increase the volumes on these routes, temporarily affecting the Level of Service. Left turns across traffic, (i.e., State Highway 120 to the Little Buffalo Basin Field road; State Highway 120 to State Highway 431; and State Highway 431 to U.S. 20) could become backed up early in the construction period with several vehicles arriving and leaving the plant site at the same time.

Increased traffic volume is related to an increase in traffic accidents. State Highway 431 has an accident probability rate close to the state average. Project-related traffic could increase that probability to above the state average. The increased use of these roads could accelerate deterioration.

Use of buses to transport workers to the plant construction site would significantly reduce vehicle miles traveled and number of vehicles on the roads. Localized traffic congestion around the bus staging area in Worland would likely occur in the morning and evening as workers converge on or exit the area in a relatively short period of time.

4.13.6 Salt Creek Project

Maximum impact to average annual traffic would occur in 1994, with a maximum daily loading of 10 buses, 19 20-ton trucks, and 74 pickup/car round trips between Casper and the construction sites. No impacts would be expected along I-25 between Casper and the exit to Midwest. Interstate 25 is a relatively new highway and is not approaching capacity.

State Highway 387 connects I-25 with the Salt Creek Field and with the towns of Midwest and Edgerton, over a distance of approximately six miles. The additional traffic volume on State Highway 387 could affect the Level of Service temporarily. This additional traffic would also temporarily increase the vehicle accident probability and could accelerate roadway deterioration.

4.13.7 Beaver Creek Alternative

The main highways serving this alternative pipeline alignment would be State Highways 135 and 136 south of Riverton and U.S. 20/26 east of Riverton.

Maximum impact to average annual traffic would include daily round trips of 8 20-ton trucks and 88 pickups/cars between Riverton and the active construction point along the pipeline. During the actual time of use, this additional traffic could affect the Level of Service and vehicle accident probability rate. This is a short-term effect, as the pipeline construction would progress at an average of two miles per day. As such, construction traffic would initially utilize State Highway 135, switching to State Highway 136 and then U.S. 20/26 as main approaches to the construction area. Much of the construction corridor would be serviced by gravel and dirt county roads and other small roads in the area.

The increased use of State Highway 135, 136 and U.S. 20/26 could accelerate roadway deterioration. Accelerated deterioration would be expected on the smaller dirt and gravel roadways used to access the pipeline corridor.

4.13.8 Frontier/Casper Alternative

The Frontier Access Section is a 24-mile-long pipeline which would be built from the Fontenelle Plant east

and then south along State Highway 372 to connect with the existing Frontier Pipeline.

Maximum daily additional loading on State Highway 372 would include 6 20-ton trucks and 88 pickup/car round trips originating in Green River. This additional traffic would further increase the temporary volume on State Highway 372, affecting the Level of Service and the vehicle accident probability rate. The additional vehicles of pipeline material and personnel movement would contribute to the deterioration of the roadway.

The Casper Section of the alternative replaces the 9-mile pipeline from the proposed Bairoil/Dakota Pipeline with 39.5 miles of pipeline emerging from the existing Frontier Pipeline near Casper. The alternative pipeline construction could contain a maximum daily loading of 6 20-ton trucks and 88 pickup/car round trips. Level of Service could be temporarily reduced for businesses and residences along the extreme southern portion of the pipeline as construction vehicles move to and from the corridor. Once away from the Casper area, the corridor would be constructed through open country. The corridor would be serviced from State Highway 259 over the northern portion of its route. Level of Service on State Highway 259 could be temporarily reduced on that particular segment adjacent to the construction area. The additional vehicles would increase the vehicle accident probability rate and accelerated deterioration of roadways could occur. Since the I-25 frontage road is a school bus route, conflicts could occur with construction worker vehicles. If the route would be used during school busing periods, additional signing could reduce potential problems. Since construction along this route is projected for summer, conflicts are not likely.

4.13.9 Exxon Alternative CO_2 Supply

Construction of Phase II of the LaBarge Project would affect a number of regional roadways, including:

- o State Highway 240;
- o U.S. Highway 189, from Kemmerer to Big Piney;
- o State Highway 372, from its junction with U.S. 189 to I-80;
- o State Highway 235 and Sublette County Road 134;
- o U.S. 189, from the Lincoln County Line north to U.S. 30;
- o U.S. 189, from Big Piney to Daniel Junction;
- o U.S. 30, from Sage Junction to Granger Junction;

Exxon (1985) projected that development of the LaBarge Project would not create "major problems" in the overall operation of the area roadway system.

4.13.10 No Action Alternative

Implementation of the No Action Alternative would not result in impacts to transportation networks.

4.14 LAND USE PLANS, CONTROLS AND CONSTRAINTS

4.14.1 Introduction

If the Proposed Actions or alternatives are constructed as planned and in accordance with mitigation measures and stipulations described in Chapter 5, no conflicts with BLM Resource Area or county land use plans are expected. The major measure mitigating conflicts with other land uses is the siting of the Proposed Actions and alternatives to follow existing pipelines. As indicated in Chapter 3, some of these routes are designated utility corridors.

Issuance of the rights-of-way would preclude most future construction on the 50-foot permanent right-of-way but would not preclude grazing or farming. Issuance of the right-of-way would not prevent future rights-of-way crossings.

Since the Proposed Actions would increase the productive life of the Elk Basin, Beaver Creek, Little Buffalo Basin and Salt Creek fields, reclamation and abandonment schedules for existing plant and field facilities would be affected by construction of the proposed projects. All new plant and field facilities would, however, be subject to reclamation plans described in general in Chapter 2 and in the project Plans of Development which would be used to permit wellfield-related activities. In general, it is reasonable to assume that implementation of the CO_2 floods would provide Amoco with an opportunity to improve the overall environment of the fields. Many of the reclamation practices and development techniques used in the early days of these fields, although consistent with standard practices and regulatory controls at the time, did not adequately mitigate or reclaim development impacts.

Project-specific areas are discussed below only where the project does not unequivocally comply with all area plans and regulations.

4.14.2 Fontenelle Project

The gas gathering system is not in one of the major existing utility corridors designated by the BLM in the project area, but does follow either existing roads or pipelines for most of its length. The gas processing plant would be adjacent to the Exxon Shute Creek Plant, a similar industrial development.

Since the Raptor Field would be developed adjacent to Fontenelle Reservoir, development of the area for CO_2 production and crossing the Green River with a sour gas gathering system could conflict with existing recreation use. With careful siting of the wells, most of these potential conflicts can be mitigated.

4.14.3 Elk Basin Project

Most of the Elk Basin Trunk Pipeline route would be constructed within BLM designated corridors. One exception is in the Grass Creek Resource Area. To follow a designated corridor in this area, the Elk Basin Pipeline would have to follow Highway 120 (Thermopolis to Cody) and then continue north into the Elk Basin Field from Cody. While this route would follow a proposed utility corridor and pipelines through the Cody Resource Area, this route was dropped from consideration because of the additional length of the pipeline and construction difficulties in the corridor. Instead, it was determined that construction in the Colorado Interstate Gas Pipeline corridor represented an acceptable and more reasonable alternative to routing the pipeline through Cody.

In the Platte River Resource Area, the Elk Basin Trunk Pipeline would follow an existing corridor, where available. Otherwise it would follow existing pipelines.

Associated Projects. There is a potential conflict between the Bairoil/Dakota Pipeline and the Lander Resource Management Plan. This section of the pipeline would cross the Oregon - Mormon Trail and pass through the Sweetwater Rocks area. The management decision to avoid these areas with new utility construction was made after the Bairoil/Dakota Pipeline right-of-way was evaluated (BLM, 1985a). A route of the Bairoil/Dakota Pipeline which would avoid the Sweetwater Rocks could be considered at the time of re-application for the right-of-way. If a new route is not considered, implementation of both the Beaver Creek Alternative and the Frontier/

Casper Alternative alignments would be necessary if the Sweetwater Rocks are to be avoided. The Oregon - Mormon Trail could not be avoided unless the No Action Alternative were implemented.

4.14.4 Beaver Creek Project

The only potential conflict associated with this project would be with the Oregon - Mormon Trail. As indicated above, the Oregon - Mormon Trail could not be avoided unless the No Action Alternative were implemented.

4.14.5 Salt Creek Project

If CO_2 for the Salt Creek Project is to be delivered from the Bairoil/ Dakota Pipeline, there is no available corridor to follow for the spur pipeline alignment. Implementation of the Frontier/Casper Alternative is, however, a viable alternative. Its implementation would more closely correspond to the Platte River Resource Area policy of following designated utility corridors.

4.14.6 Frontier/Casper Alternative

Most of the Casper Section would follow a designated corridor. Where the alternative route diverges from the designated corridor, it does so to avoid conflicts with housing north of Casper.

4.14.7 Exxon Alternative CO_2 Supply

Since all of the Phase II facilities would be adjacent to existing, similar facilities, it is not expected that this project would conflict with current land use plans.

4.14.8 No Action Alternative

Implementation of the No Action Alternative would not conflict with any specific land use plans.

4.15 HEALTH AND SAFETY

Impacts to the health and safety of the general public and to the construction and operation workforce are considered significant if the National or Wyoming Ambient Air Quality Standards or the Prevention of Significant Deterioration regulations were exceeded (see Table 3-19). Neither the Proposed Actions of alternatives would violate these standards or regulations. Established construction and operation practices in the oil and gas industry have greatly reduced health and safety concerns to the general public and to oil and gas field workers. However, impacts could occur during development of the Raptor CO_2 Field from a well blowout resulting in the release of sour gas or from ruptures of CO_2 or sour gas pipelines.

Amoco will provide buses for workers who live in Green River, Powell, Worland, Riverton and Casper during the construction of the projects in these areas. This should help reduce traffic associated with workers driving to and from work which in turn should reduce impacts to the general public and workers from related accidents.

4.15.1 Fontenelle Project - Well Development

Impacts from an H_2S release could occur if there were a blowout during drilling of the Raptor Field or if there were a pipeline rupture or leak in the gas gathering system. The probability of a well blowout during drilling is estimated at 1 blowout for every 630 wells.

During production, the blowout rate is 1 well per 3,000 well-years (BLM, 1983d). Using these probabilities, it was estimated for the Riley Ridge EIS that 2.8 blowouts would occur from the proposed 238 wells to be produced during the 30- to 40-year project life. Only ten wells are proposed in the Raptor Field with a project life of 30 to 40 years. Using these probability calculations, the Raptor Project has a much lower probability of a blowout with less than one blowout expected for the project life (probability of .01). It was also estimated for the LaBarge Project that a lethal dose of H_2S could be received within one-quarter to one-half mile of a well. Within one to two miles of a well, it was projected that a person could receive a discomforting dose from a blowout (BLM, 1983d). The composition of the gas used in the Riley Ridge analysis had a concentration of 4 percent H_2S, which is over three times the concentration of H_2S in the Raptor Field. With a lower H_2S concentration, dispersion of H_2S in Raptor Field gas should occur more rapidly and the lethal and discomfort dose distances should be less than the distances indicated above. While these distances are not currently known, Amoco would use dispersion modeling in developing the H_2S contingency plans for the field.

Amoco would prepare detailed H_2S contingency plans for all development wells drilled in the Raptor Field. These plans would include: H_2S well controls, restricted public access, evacuation plans, safety areas, emergency fire and breathing equipment, warning devices, flaring of uncontrolled blowouts, and other appropriate measures. H_2S contingency plans greatly reduce the possibility of significant impacts to drilling crews and to the general public in the event of an H_2S blowout (Wyoming Office of Industrial Siting Administration, 1986).

4.15.2 All Projects - Pipeline Ruptures

The BLM (1983d) estimated that the probability of a rupture on a gathering pipeline or trunkline is 1 rupture per 5,000 mile-years (or .0002 per mile per year). In addition to normal ruptures, a House of Representatives committee report on recent pipeline legislation expressed fear that "a CO_2 pipeline might not behave in a fashion similar to other pipelines. Some individuals have speculated that if a CO_2 pipeline ruptures, the unusually large energy release might not restrict the rupture to a discrete area and, in fact, the pipeline might split like a banana peel until the break reaches a compression station" (Crow, 1988). While the potential for ruptures cannot be eliminated entirely, the tendency of CO_2 pipelines to split can be controlled by crack arresters. The use of crack arresters would be addressed in the POD.

The proposed Raptor Gas Gathering System would be approximately 24 miles long and have a project life of 30-40 years. Using the probabilities, a rupture would occur 0.17 times during the project's life. It was also estimated that release of H_2S could be lethal at distances up to four miles and could be discomforting at a distance of six miles for gathering lines. For trunklines with a diameter of 30 inches BLM estimated that a rupture of H_2S could be lethal at a distance of three miles and discomforting to a distance of seven miles, depending on the meteorological conditions at the time of the release (BLM, 1983d).

If ruptured, the Fontenelle Gas Gathering System should be less likely to significantly affect the health and safety of the public compared to the LaBarge Project, since the pipeline would be shorter, of smaller diameter and the concentration of H_2S in the pipeline would be significantly less. Consequently, if a rupture occurred, a smaller volume of H_2S

would be released. The closest proximity of the Fontenelle Project sour gas pipelines to the general public is at the Green River crossing and in the Fontenelle Reservoir area, both of which are popular recreation sites. Block valves which control the amount of gas released in the event of a rupture are typically placed every 20 miles. Because the Fontenelle Gas Gathering system would carry sour gas near recreation areas, a shorter distance between block valves may be necessary to assure the public safety. The spacing of valves would be addressed in the POD after a risk assessment study.

The trunk and spur CO_2 pipelines would not carry sour gas and consequently the health and safety concerns of these pipelines are significantly reduced. The main concern is from possible CO_2 pipeline ruptures. Table 4-25 indicates the potential for a pipeline rupture based on the length of each proposed and alternative pipeline and injection and production lines in each field. If a LO-CAT gas sweetening system is not used at the recycle plants, sour gas would be recycled into the fields. Under this scenario, both production and injection pipelines in the fields would carry sour gas.

Risks to the health and safety of the public should be very low in the event of a rupture of trunk, spur and most wellfield pipelines, due primarily to the rural nature of the pipeline alignments. Also, Amoco will follow approved construction requirements which will minimize the possibility of a rupture. Internal and external corrosion protection and monitoring equipment would be installed on each pipeline. The pipeline routes will also be well posted to reduce the possibility of an accidental rupture by any type of construction activities.

Construction requirements in and around the towns of Midwest and Edgerton for the Salt Creek project will be type C, which are more stringent than the other projects due to the increased populations in these areas. Type C construction requirements will also be used in any areas where the pipeline is above the ground. If sour gas recycling is implemented, Amoco would prepare a detailed H_2S contingency plan for the Salt Creek Field.

Table 2-8 lists the number of miles of injection and production pipeline which presently exist in each field.

It is reasonable to assume that the miles of pipeline associated with production and injection of CO_2 would be similar to the miles listed on Table 2-8. Comparing each of these projects, the possibility of a pipeline rupture would most likely occur within the Elk Basin Field since this project has the greatest number of miles of pipeline.

4.15.3 No Action Alternative

Implementation of the No Action Alternative would not result in impacts to the health and safety of the general public or to the construction and operations workforce.

Table 4-25. Potential for Pipeline Ruptures for Proposed Action and Alternative Pipelines. (a)

Project	Sour Gas Pipeline Ruptures Predicted in 40 years (b)	Non-sour Gas Pipeline Ruptures Predicted in 40 years (c)
Fontenelle	0.43	
Elk Basin	0.20	0.18
Beaver Creek	0.06	0.06
Little Buffalo	0.10	0.08
Salt Creek	0.16	0.15
Beaver Creek Alternative		0.04
Frontier/Casper Alternative		0.05

a = Calculaltions based on predictions for pipeline ruptures for the Riley Ridge Natural Gas Project (BLM, 1983d).
b = Includes only field production pipelines.
c = Includes trunk and spur pipelines in addition to injection pipelines in fields.

CHAPTER 5
MITIGATION MEASURES AND UNAVOIDABLE IMPACTS

5.1 MITIGATION MEASURES

Measures designed to reduce or eliminate the *impacts* of one or more aspects of a project may be:

- o Incorporated into the project design (Chapter 2);
- o Required as standard stipulations by appropriate agencies (Appendix 1); or
- o Required for a particular portion of the project area (Chapters 3 and 4).

All three types of *mitigation* measures discussed in Chapters 1 through 4 are summarized in Table 5-1 (see also Table 5-2 for a summary of wildlife seasonal surface use restrictions). The table includes the mitigation measure, whether it is a commitment made by Amoco or will be included as a stipulation by *BLM* to the right-of-way grant. As final alignments are surveyed and the PODs prepared, additional site-specific mitigation measures may be developed by Amoco or required by BLM.

5.2 COMMITMENT OF RESOURCES

Discussions of each resource in Chapter 4 describe whether or not a resource will be impacted by the proposed projects and their alternatives. Some of these impacts are short-term, i.e., lasting during construction and/or for up to five years after construction. Others, long-term impacts, may last for several years, for the life of the project or may represent a permanent alteration to the environment.

Impacts of a project may also be described in terms of irreversible or irretrievable commitments of resources. A commitment of resources is irreversible if it limits the future options for a resource. Irreversible applies primarily to the effects on the use of nonrenewable resources, such as minerals. An irretrievable commitment of resources refers to loss of current use of a resource. For example, a project may disturb crop production for one season. The crop production is irretrievably lost for one year unless productivity of the field would be enhanced by the project.

Table 5-3 indicates whether the effects of the proposed projects and their alternatives would be long-term or short-term and indicates if a resource would be irreversibly or irretrievably affected.

5.3 UNAVOIDABLE ADVERSE IMPACTS

Several factors have minimized the unavoidable adverse impacts of the proposed projects and their alternatives. The *enhanced oil recovery* projects have been sited in oil fields with existing disturbance. Pipelines to supply CO_2 to the fields have been carefully sited to follow designated *corridors* or existing pipeline routes, wherever possible or environmentally reasonable. With environmentally reasonable project design coupled with effective implementation of the mitigation measures summarized in Chapter 5, the unavoidable adverse impacts of the proposed projects are expected to be minimal and primarily short-term.

The Fontenelle Project's Raptor Field is the only exception to the siting of project components in previously disturbed areas. Impacts to the environment and recreational land use would remain after well siting restrictions, seasonal construction constraints, safety measures and *reclamation* are implemented. These site-specific impacts cannot be avoid-

Table 5-1. Summary of Mitigation Measures.

Mitigation Measures	Proposed Actions (a)	BLM Standard Practices and Mitigation (b)	Army Corps of Engineers (b)	Environmental Protection Agency (b)	Project-Specific Mitigation (c)
	Required or Proposed by:				
SOCIOECONOMIC CONDITIONS					
Bus plant construction workers to communities best suited to accommodate growth.	X				
Maximize use of local labor through Wyoming Job Service Centers.	X				
SOILS AND VEGETATION					
The applicant's Construction and Operation Plan will have a detailed reclamation plan tailored to each land condition encountered; the plan implementation will be directed by an on-site reclamation specialist.					X
Existing roads will be used to access the right-of-way and, where possible, to minimize surface disturbance.		X			
Any new roads will be required to follow natural contours; be constructed in accordance with standards as described in BLM Road Standards and BLM Manual section 9113; and be reclaimed to BLM standards. (See Appendix 1 for more detail on roads.)		X			
Only areas needed for construction will be allowed to be disturbed.		X			
The right-of-way will be cleared and/or graded only where necessary to maintain a safe working surface.	X				
Surface disturbance will be prohibited on slopes in excess of 25 percent.		X			
No construction will be allowed with frozen material or during periods when the soil material is frozen.		X			
Reclamation will be required on all disturbed areas.		X			
Reclamation will be initiated as soon as possible after a disturbance occurs.		X			
Construction is subject to suspension during the wet season.	X				
Trees, shrubs and ground cover (not to be cleared from the rights-of-way) will require protection.		X			

Table 5-1. Continued.

Mitigation Measures	Proposed Actions (a)	BLM Standard Practices and Mitigation (b)	Army Corps of Engineers (b)	Environmental Protection Agency (b)	Project-Specific Mitigation (c)
	Required or Proposed by:				
Where topsoil removal is necessary, it will be stockpiled (windrowed) and respread over the disturbance after construction is complete.		X			
On large surface disturbing projects (e.g., gas processing plants), topsoil will be stockpiled, mulched and seeded to reduce erosion (see Appendix 1 for detailed specifications).		X			
Before a surface disturbing activity is authorized, the BLM will determine total topsoil depth, the amount of topsoil to be removed, along with topsoil placement areas.		X			
Vegetation removed from the right-of-way will be respread to provide protection, nutrient recycling and a natural seed source.		X			
Reclamation will be initiated as soon as possible after a disturbance occurs and continued efforts will be required until satisfactory vegetation cover is established and the site is stabilized.		X			
Only plant species adaptable to local soil and climatic conditions will be utilized (see Appendix 1 for other criteria related to seeding).		X			
Any mulch used will be free from mold, fungi or noxious weed seeds (see Appendix 1 for kinds of mulch permitted).		X			
The grantee will be responsible for the control of all noxious weed infestations on surface disturbances.		X			
Backfill will be required to be placed in a similar sequence and density to preconstruction condition.		X			
The ground contour will be restored to permit normal surface drainage.		X			
To promote soil stability, the compaction of backfill will be required (not to extend above the original ground level after the fill has settled).	X				
Continued efforts will be required until satisfactory vegetation cover is established and the site is stabilized.		X			
Water bars, mulching and terracing will be required, as needed, to minimize erosion.		X			

Table 5-1. Continued.

Mitigation Measures	Required or Proposed by: Proposed Actions (a)	BLM Standard Practices and Mitigation (b)	Army Corps of Engineers (b)	Environmental Protection Agency (b)	Project-Specific Mitigation (c)
The Casper Section alignment will be realigned to minimize impacts on Teapot and Casper creeks. Details of the realignments would be adressed in the POD.					X
Specific site studies will address realignment of the Beaver Creek Alternative alignment to minimize steep slope construction near Badwater Creek and near Bridger Creek.					X
AGRICULTURE					
Construction will be coordinated to prevent interference with livestock trailing, irrigation and other activities.	X				X
Functional use of all livestock improvements will be maintained at all times (e.g., watering areas).	X				
All structures such as terraces, levees, underground drainage systems, irrigation pipelines and canals will be restored to preconstruction conditions so that they function as originally intended.	X				
The soils (backfill) within the trench will be compacted and the crown smoothed to match the bordering area and allow surface irrigation.	X				
The fencing of linear disturbances near livestock watering areas may be required.		X			
WATER RESOURCES					
Existing roads and bridges will be used to cross all streams unless other access is specifically authorized.					X
Temporary crossings will be removed upon completion of the project. All stream channels and washes will be returned to their natural state.			X		
In-stream protection structures (e.g., drop structures) may be required in drainages crossed by a pipeline to prevent erosion.		X			
A buffer strip will be maintained between staging areas and the high water line of streams.	X				
Surface disturbance will be prohited within 500 feet of surface water and(or) riparian areas (except for exceptions approved in writing).		X			

Table 5-1. Continued.

Mitigation Measures	Proposed Actions (a)	BLM Standard Practices and Mitigation (b)	Army Corps of Engineers (b)	Environmental Protection Agency (b)	Project-Specific Mitigation (c)
	Required or Proposed by:				
Construction equipment will be refueled and maintained outside of stream channels.	X				
Water used for the hydrotest will be obtained and disposed of in accordance with regulations. Permits will be obtained as required.	X				
The rights-of-way at stream crossings will be restored as nearly as possible to preconstruction states immediately after completion of construction.	X				
Discharges of dredged or fill material into United States waters should be avoided or minimized through the use of other practical alternatives.			X	X	
If any discharge creates an impoundment, adverse impacts on the aquatic system caused by the accelerated passage of water or the restriction of its flow should be minimized.			X		
Discharges in wetlands should be avoided.			X		
Heavy equipment used in wetlands should be placed on mats.			X		
All temporary fills should be entirely removed.			X		
Preconstruction bottom contours cannot change. (Excess material must be removed to an upland disposal area.)	X		X		
The discharge cannot occur in the proximity of a public water supply intake structure.			X		
The discharge must consist of suitable material that is free of toxic pollutants in other than trace amounts.			X		
The fill created by a discharge must be properly maintained to prevent erosion and other nonpoint pollution sources.			X		
Plant site runoff and other waste water will be drained to an underground sump and then injected into an off-site disposal well.	X				

Table 5-1. Continued.

Mitigation Measures	Proposed Actions (a)	BLM Standard Practices and Mitigation (b)	Army Corps of Engineers (b)	Environmental Protection Agency (b)	Project-Specific Mitigation (c)
	Required or Proposed by:				
WILDLIFE					
In-stream construction on streams with naturally spawning gamefish will avoid spring and fall spawning and incubating periods.	X		X	X	
The publication cited in the following stipulation provides sufficient information on phase spacing, configuration and grounding to preclude the existence of significant hazards to large perching birds. A copy of this publicaiton may be obtained from the BLM.		X			
Unless otherwise agreed upon in writing, power lines shall be constructed according to standards as in "Suggested Practices for Raptor Protection on Power Lines," Raptor Research Foundation, Inc., 1981. Industry officials shall assume the burden and expense of proving that pole design not shown in publications are "eagle safe." Such proof shall be provided by a raptor expert approved by the Authorized Officer. The BLM reserves the right to modifications or additions to all power line structures placed on this right-of-way, should they be necessary to ensure the safety of large perching birds. Such modifications and/or additions shall be made by the holder without liability or expense to BLM.		X			
To protect important big game ungulate winter habitat, drilling and other surface-disturbing activity will not be allowed during the period from November 15 to April 30 within the certain areas encompassed by this lease (right-of-way). The same criteria applies to elk calving areas from the period of May 10 to June 30. This limitation does not apply to maintenance and operation of producing wells. Modifications of this limitation in any year may be approved in writing by the Authorized Officer (see Table 5-2).		X			
To protect important raptor and/or sage and sharp-tailed grouse nesting habitat, drilling and other surface-disturbing activity will not be allowed during the period from February 1 to July 31 within certain areas encompassed by this lease (right-of-way). This limitation does not apply to maintenance and operation of producing wells. Modifications of this limitation in any year may be approved in writing by the Authorized Officer (see Table 5-2).		X			

Table 5-1. Continued.

Mitigation Measures	Proposed Actions (a)	BLM Standard Practices and Mitigation (b)	Army Corps of Engineers (b)	Environmental Protection Agency (b)	Project-Specific Mitigation (c)
	Required or Proposed by:				
No surface occupancy will be allowed on that portion of the lease (right-of-way) within the following defined area for the purpose of protecting habitat (e.g., sage/sharp-tailed grouse strutting grounds) (legal descriptions will be listed in POD). Modifications of this limitation in any year may be approved in writing by the Authorized Officer.		X			
Adequate inventories of any listed threatened or endangered species will be performed; consultation with the U.S. Fish and Wildlife Service will detail mitigation measures.	X				
Only raptor-safe electrical poles will be used.					X
Adequate surveys for raptors and sage grouse leks will be conducted.					X
Wyoming Game and Fish will be reimbursed for any fish kills.					X
Discharges should not restrict or block the movement of aquatic species indigenous to the waters, impede the passage of normal or expected high flows, or cause the relocation of the waters (unless the main purpose of the fill is to impound water).			X		
Discharges into breeding and nesting areas for migratory waterfowl should be avoided.			X		
The discharge cannot destroy a threatened or endangered species as identified under the Endangered Species Act or endanger the critical habitat of such species.			X		
The discharge cannot disrupt the movement of aquatic species indigenous to a water body.			X		
No firearms or dogs should be allowed at the work site.					X
Recommend use of deer whistles to reduce risk of auto collision.					X
AIR QUALITY					
The pipeline right-of-way and access roads should be watered as needed to control construction dust.					X

Table 5-1. Continued.

Mitigation Measures	Required or Proposed by: Proposed Actions (a)	BLM Standard Practices and Mitigation (b)	Army Corps of Engineers (b)	Environmental Protection Agency (b)	Project-Specific Mitigation (c)
CULTURAL RESOURCES					
Surface disturbance will be prohibited within a quarter mile or visual horizon (whichever is closer) from historic trails.		X			
The Memorandum of Agreement on cultural resources must be followed.	X				
Conduct Class III surveys of all rights-of-way before construction.	X				
Strictly limit right-of-way blading when crossing trails; develop special revegetation procedures to minimize vegetation recover time.					X
PALEONTOLOGICAL RESOURCES					
All sensitive formations will be intensively surveyed before construction.	X				
A mitigation plan based on this survey will be developed and implemented.	X				
Any paleontological resources found during construction will be brought to the attention of the authorized officer and construction will cease until the applicant is authorized to proceed.	X				
VISUAL RESOURCES					
Surface disturbance will be prohibited within important scenic areas (Class I and II Visual Resource Management areas).		X			X
Structures and pipelines will be constructed adjacent to similar features.	X				
RECREATION					
Notify construction workers of approved access roads and special "off limits" areas (e.g., historic trails); prohibit off-road driving during construction.					X
Provide busing for construction workers.	X				
Minimize disturbance during construction of all historic trails and other known recreation sites; monitor revegetation and restore areas as necessary.					X
Prohibit firearms on the job site.					X

Table 5-1. Continued.

Mitigation Measures	Proposed Actions (a)	BLM Standard Practices and Mitigation (b)	Army Corps of Engineers (b)	Environmental Protection Agency (b)	Project-Specific Mitigation (c)
	Required or Proposed by:				
Discourage vandalism, poaching and destructive "plinking"; provide contractual penalties.					X
Contractually require observance of length of stay restriction in campgrounds and 14 day camping limitations on BLM land.					X
Where housing and/or RV parking is limited, provide RV parking sites.					X
Clearly notify potential workers of where and when jobs are available to avoid squatting by job seekers.					X
Site wells and roads out of line of sight from developed recreation resources where possible.					X
Monitor odors and take remedial action if they are detectable near recreation areas.					X
See also mitigation measures for wildlife, water, visual, cultural and vegetation resources.					
WILDERNESS					
Site all project components outside the boundary of WA's and WSA's.	X				
TRANSPORTATION					
The right-of-way will be used as an access road only during construction and for emergencies after construction.					X
The applicant will control off-road vehicle use of the right-of-way.					X
The applicant will not lock or close gates or cattle guards unless they were already locked or closed.	X				
The applicant will comply with all requirements for protecting all transportation facilities, e.g., road surfaces, cattle guards, etc.	X				
The applicant will restore all roads damaged as a result of the project.	X				
All state highway crossings will be dry bored.	X				
On smaller roadways, an unexcavated ditch line will be provided to allow safe and unimpeded travel.	X				

Table 5-1. Continued.

Mitigation Measures	Required or Proposed by: Proposed Actions (a)	BLM Standard Practices and Mitigation (b)	Army Corps of Engineers (b)	Environmental Protection Agency (b)	Project-Specific Mitigation (c)
All plant and field construction workers will be bused to work.	X				
HEALTH AND SAFETY					
All drilling operations must conform to an approved H2S contingency plan.	X				
All plants will be surrounded with a security fence with one-way panic gates.	X				
Design construction and testing of materials installations, procedures and completed systems in accordance with all applicable national standards (ANSI and ASME).	X				
All pipeline construction will be in class 1 safety areas.	X				
Block valves will be placed at origin stations, meter stations and every 20 miles.	X				
The need for closer spacing of block valves on the the Fontenele Gas Gathering system will be addressed in the POD after a risk analysis.					X
Because the pipeline will carry sour gas additional block valves will be placed on both sides of the Green River.	X				
Area residents and farmers/ranchers will be notified of blasting activities.	X				
No ditches will remain open for more than 14 days.	X				
The pipe will be tested for leaks at 1.25 times its maximum operating pressure.	X				
Use of crack arrestors will be addressed in the POD.	X				
Each plant site will have a sanitary sewer system; new systems will be built as necessary.	X				
Construction sites will be maintained in a sanitary condition at all times and waste will be dumped only in authorized disposal sites.	X				

a = Measures described in Chapter 2.
b = Measures provided in more detail in Appendix 1.
c = Recommended actions in Chapter 4.

Table 5-2. Summary of Wildlife Seasonal Surface Use Constraints.

Project	Species	Milepost	Surface Use Restriction
FONTENELLE			
Pipeline	Sage Grouse	0-2.2	February 1 - July 31
	Moose	7-13.5	November 15 - April 30
	Bald Eagle Winter Concentration Area	9.6-9.8	November 15 - March 15
	Deer & Antelope	2W-7.5W	November 15 - April 30
Plant Site	Sage Grouse	(a)	February 1 - July 31
Wellfield	Moose	(a)	November 15 - April 30
	Deer & Antelope	(a)	November 15 - April 30
	Golden Eagle (2)	(a)	February 1 - July 31
	Red-Tail Hawk	(a)	February 1 - July 31
	Ferruginous Hawk (2)	(a)	February 1 - July 31
	Prairie Falcon	(a)	February 1 - July 31
	Bald Eagle Winter Concentration Area	(a)	November 15 - March 15
	Whooping Cranes	(a)	April 1 - October 30
Elk Basin			
Pipeline	Sage Grouse	0-9.4	February 1 - July 31
	Great Horned Owl	27.5-28.5	February 1 - July 31
	Sage grouse	29.8-34.2	February 1 - July 31
	Kestrel	32.0-33.0	February 1 - July 31
	Golden Eagle	32.5-33.5	February 1 - July 31
	Sage Grouse	35.6-41.4	February 1 - July 31
	Burrowing Owl	39.5-40.5	February 1 - July 31
	Golden Eagle	39.5-40.5	February 1 - July 31
	Ferruginous Hawk	61.0-64.0	February 1 - July 31
	Deer & Antelope	69.0-73.1	November 15 - April 30
	Antelope	80.2-85.4	November 15 - April 30
	Deer	102.4-108.4	November 15 - April 30
	Antelope	108.4-117.4	November 15 - April 30
	Red-Tail Hawk	113.0-114.0	February 1 - July 31
	Ferruginous Hawk	117.0-119.0	February 1 - July 31
	Ferruginous Hawk (2)	120-124	February 1 - July 31
	Sage Grouse (2)	121.0-127.0	February 1 - July 31
	Deer & Antelope	121.2-134.1	November 15 - April 30
	Antelope	134.2-143.1	November 15 - April 30
	Deer	135.0-136.0	November 15 - April 30
	Sage Grouse	139.7-143.2	February 1 - July 31
	Antelope	146.8-147.8	November 15 - April 30
	Antelope	155.1-155.9	November 15 - April 30
	Feruginous Hawk	158.0-162.5	February 1 - July 31
	Ferruginous Hawk	169.0-172.0	February 1 - July 31

Table 5-2. Continued.

Project	Species	Milepost	Surface Use Restriction
Plant Site	2- Sage Grouse nesting/ rearing habitat	(a)	February 1 - July 31
Wellfield	3- Sage Grouse nesting/ rearing habitats	(a)	February 1 - July 31
Associated Project:			
(Bairoil/Dakota	Deer & Antelope	112.0-136.0	November 15 - April 30
Milepost 112-185)	Elk Calving Area	114.5-115.5	May 1 - June 30
	Sage Grouse	160.0-164.0	February 1 - July 31
	Unknown Raptor	165.0 (a)	February 1 - July 31
	Sage Grouse	168.0-173.0	February 1 - July 31
	Unknown Raptor	171.0 (a)	February 1 - July 31
	Unknown Raptor	174.5 (a)	February 1 - July 31
	Bald Eagle/Winter Concentration Area	180.0-185.0	November 1 - March 31
	Sage Grouse	181.0-182.0	February 1 - July 31
	Elk	180.0-185.0	November 15 - April 30
BEAVER CREEK			
Pipeline	Antelope	0-2.1	November 15 - April 30
	Antelope	21.5-38.6	November 15 - April 30
	Sage Grouse	30.8-34.3	February 1 - July 31
Plant Site	Antelope	(a)	November 15 - April 30
Wellfield	Antelope	(a)	November 15 - April 30
	Burrowing Owl	(a)	February 1 - July 31
LITTLE BUFFALO BASIN			
Pipeline	Sage Grouse	0.2-2.4	February 1 - July 31
	Sage Grouse	3.2-7.4	February 1 - July 31
	Antelope	4.6-8.6	November 15 - April 30
	Sage Grouse	8.9-15.3	February 1 - July 31
	Ferruginous Hawk	15.0	February 1 - July 31
	Sage Grouse	20.2-24.1	February 1 - July 31
	Sage Grouse	27.7-30.0	February 1 - July 31
Plant Site	6-Sage Grouse Nesting/ rearing habitats	(a)	February 1 - July 31
Wellfield	6-Sage Grouse Nesting/ rearing habitats	(a)	February 1 - July 31
	Deer & Antelope	(a)	November 15 - April 30

Table 5-2. Continued.

Project	Species	Milepost	Surface Use Restriction
SALT CREEK			
Pipeline	Unidentified Buteo	5.0	February 1 - July 31
Associated Projects	Antelope	185.0-195.0	November 15 -April 30
(Bairoil/Dakota	Raptor Nests	(a)	February 1 - July 31
Milepost 185-221)	Sage Grouse	197.0-199.0	February 1 - July 31
BEAVER CREEK ALTERNATIVE			
Pipeline (b)	Antelope	23.0-26.3	November 15 - April 30
	Golden Eagle	38.0	February 1 - July 31
	Deer & Antelope	47.0-55.0	November 15 - April 30
FRONTIER/CASPER ALTERNATIVE			
Frontier Access	Sage Grouse	5.9-9.6	February 1 - April 30
Section	Sage Grouse	15.9-19.5	February 1 - April 30
	Sage Grouse	22.8-24.0	February 1 - April 30
EXXON ALTERNATIVE			
CO2 Supply			
Feed Gas Trunkline	Deer & Antelope	5.5-23.0	November 15 - April 30
	Whooping Crane	10.0-13.0	April 1 - October 30
	Moose	15.0-16.0	November 15 - April 30
	Moose	23.0-24.0	November 15 - April 30
	Moose	32.0-33.0	November 15 - April 30
	Deer & Antelope	24.0-31.5	November 15 - April 30
	Sage Grouse	25.0- 28.5	February 1 - July 31
	Elk	5.5-8.5	November 15 - April 30
	Elk	14.5-17.0	November 15 - April 30
Plant Site	Sage Grouse	(a)	February 1 - July 31
Wellfield	3-Golden Eagle Nests	(a)	February 1 - July 31
	2-prairie Falcon Nests	(a)	February 1 - July 31
	Goshawk	(a)	February 1 - July 31
	9-Sage Grouse nesting/ rearing habitats	(a)	February 1 - July 31
	Deer	(a)	November 15 - April 30
	Elk	(a)	November 15 - April 30
	Moose	(a)	November 15 - April 30
	Big Horn Sheep	(a)	November 15 - April 30

(a) Surface use restrictions would be based on the proximity of surface activity to critical habitat or nests within the wellfield or near the plant site

(b) From preliminary baseline maps.

Table 5-3. **Resource Commitments.**

Element	Impacts: Short-term	Impacts: Long-term	Commitments of Resources: Irreversible	Commitments of Resources: Irretrievable
SOCIOECONOMICS				
Population increase	x			
Significant local government revenue increase from construction	x			
Significant local government revenue increase from operation		x		
SOILS AND VEGETATION				
Soil stability or productivity	x			x
Vegetation cover	x (a)	x (b)		x
Special species or communities				
AGRICULTURE				
Cropland/crop production	x			x
Forage	x (a)	x (b)		x
WATER RESOURCES				
Water quality	x			x
WILDLIFE				
Big game crucial winter range	x			x
Grouse breeding/nesting habitat	x			x
Raptor nesting habitat				
Threatened or endangered species				
Riparian habitat	x			x
AIR QUALITY	x (a)	x (b)		x
CULTURAL RESOURCES				
Known sites	x	x	x	x
Crossing of historic trails and roads (some crossed more than once)	x	x	x	x
MINERALS/PALEONTOLOGICAL RESOURCES				
Coal/minerals precluded from recovery		x		x
Paleontological resources		x	x	x
VISUAL RESOURCES				
Class I or II areas				
Other areas		x		x
RECREATION RESOURCES				
Physical Distrubance to sites	x	x		
Population impacts to experience	x			x
WILDERNESS (Study Areas Only)				
Physical characteristics of areas				
Solitude in or enjoyment of area	x			x
TRANSPORTATION				
Human health and life	x		x	x
Segments of major roads	x			
Traffic flow	x			
HEALTH AND SAFETY		x		x

a = Short-term impacts will result from construction activities associated with pipelines, plants and wellfields.
b = Long-term impacts would be associated with plants.

ed without using a different source of CO_2 for the enhanced oil recovery projects (such as Exxon's LaBarge Project). As indicated in Chapter 2, use of a different CO_2 source has other unacceptable and equally severe consequences.

For the spur and trunk pipelines, the adverse impacts that can not be reasonably mitigated are unavoidable because of the nature of pipeline construction. The linear rights-of-way cannot, in most cases, avoid crossing rivers and the pipeline cannot be buried without trenching. While most of these impacts are short-term, a minimal area is required for the life of the project for support structures. Most of these structures are required for safe operation of the system (e.g., block valves) or conservation of resources and economical operation of the project (e.g., the CO_2 recycle plants).

Unavoidable short-term impacts from all projects would include land surface disturbance resulting in vegetation cover loss and, consequently, loss of wildlife and livestock *forage* and an increased potential for erosion. Wildlife will also be disturbed (during non-critical times) along the pipeline route and by wellfield and plant activities. Short-term degradation of water quality would occur at pipeline stream crossings. Minor air quality degradation is expected from *fugitive dust* and construction equipment *emissions* along the rights-of-way and in wellfields. Construction-related vehicles would increase traffic and is likely to cause accelerated deterioration of some roadways.

Both long- and short-term impacts to recreation, wilderness areas and visual resources can be expected due to noise of construction and visibility of the reclaimed pipeline alignment, but these impacts would be minor because of the location of all facilities adjacent to similar disturbances. Similar impacts to cultural resources (e.g., *historic* trails) would result from construction. Long-term impacts to cultural sites should be minor after mitigation measures are implemented.

Minor adverse impacts to minerals would be the preclusion of small areas from mining. The principal impact to mineral resources would be the positive impact on the recovery of oil resources in the targeted fields. Similarly, socioeconomic impacts are expected, on the whole, to be positive.

5.4 CUMULATIVE IMPACTS

If all five of the proposed projects or their alternatives are built, it is not expected that they would result in a significant *cumulative impact* on either the human or natural environment. There would be no cumulative impact significantly greater than the impacts of individual projects because the projects are separated in both time and location and because the unavoidable adverse impacts of the individual projects are minimal.

Two other pipeline segments must be built coincident with construction of the Elk Basin and Salt Creek projects. These are the Bairoil/Dakota CO_2 Pipeline from mileposts 112 to 187 (75 miles) for the Elk Basin Project and from mileposts 187 to 221 (34 miles) for the Salt Creek Project. Because this construction would take place at the same time and adjacent to a proposed project, impacts of this construction would be considered cumulative to that of the proposed projects. The impacts of this construction are discussed in detail in the Bairoil/Dakota CO_2 Projects EIS (BLM, 1985a). If, however, the Beaver Creek Alternative alignment to the Elk Basin Project and the Frontier/Casper Alternative to the Salt Creek Project were built, they would not require construction of any of the Bairoil/Dakota Pipeline and would not, therefore, result in any cumulative impacts.

Wherever the proposed projects and/or their alternatives follow an existing

pipeline, the impact of the new construction must be considered as an impact added to the residual impact of the existing pipeline. The most common residual impacts would be to vegetation productivity (for livestock and wildlife), visible differences in vegetation affecting visual quality of the area, and any irreversible impacts to resources such as cultural and paleontological sites. While these are all cumulative impacts that must be recognized, land use planning has determined that benefits of concentrating utilities in corridors usually outweigh the negative cumulative impacts.

A Pacific Power and Light 230 kV transmission line from the vicinity of Alcova to Crooks Gap is expected to be built in 1990. This project may draw workers from the same communities as the Elk Basin project. The *workforce*, however, is projected at about 60 workers and is not expected to result in a major cumulative impact. No other projects have been identified which would result in cumulative impacts.

CHAPTER 6
CONSULTATION AND COORDINATION

6.1 TEAM ORGANIZATION

Cooperating Agencies

Army Corps of Engineers
Bureau of Indian Affairs

Bureau of Land Management - Lead Agency

Casper District Office
Project Environmental Coordinator
Glen Nebeker

Worland District
Mike Rutledge

Rawlins District
Mary Hanson

Rock Springs District
Bill McMahan

Miles City, Montana, District
Rob McWhorter

Wyoming State Office
Eugene Jonart

Planning Information Corporation - Principal Contractor

Name	Education	EIS Responsibility
Aaron L. Clark	M.S., Biology B.A., Biology	Project Manager, Project Description
George Blankenship	M.A., Urban Planning B.A., Anthropology B.A., Social Work	Socioeconomic Conditions
Michael Busdosh	PhD., Biology B.S., Zoology	Wildlife, Water
Dan Duce	M.S., Soils Science B.S., Range Science	Air Quality,Wildlife, Health and Safety
Jed Goldstein	M.A., Urban Planning B.A., Sociology	Socioeconomic Conditions
Marcia Gross	B.A., Environmental Studies	Transportation, Paleontology
Kathryn Mutz	M.S., Biology A.B., Geography	Soils, Vegetation, Agriculture
Mary Robbins-Wade	B.A., Anthropology	Minerals, Data collection

Name	Education	EIS Responsibility
Jennifer Sebesta	M.A., Planning an Community Development B.A., Geography	Socioeconomic Conditions
Elaine Taylor	M.A., English M.A., Planning and Community Development	Recreation, Land Use, Socioeconomic Conditions
James Williams	M.A., Urban Planning B.A., English	Socioeconomic Conditions
Myra Atencio		Logistics, Word Processing
Pat Culley		Word Processing, Editing
Phaka Hak		Data Input
David Hemsi		Graphics
Susan Malarkey		Data Input
Kimberly Wille	B.A., Fine Arts	Graphics

Powers Elevation, Inc.

Name	Education	EIS Responsibility
Marcia Tate	M.A., Anthropology B.A., Anthropology	Cultural Resources Principal Investigator
Paul Friedman	M.A., History B.A., Anthropology B.A., History	Cultural Resources
John Gooding	M.A., Anthropology B.A., Anthropology	Cultural Resources
Robert Mutaw	PhD., Anthropology M.A., Anthropology B.A., Anthropology	Cultural Resources
Gregory Newberry	M.A., Anthropology B.A., Anthropology	Cultural Resources

6.2 SCOPING AND ISSUES IDENTIFICATION

Public Scoping

Any time the Federal Government considers approving any action on lands within its jurisdiction which may result in significant *impacts* to the human environment, an Environmental Impact Statement must be prepared. Environmental Impact Statements aid federal officials in making their decisions by presenting the environmental and socioeconomic effects of a proposed project and its alternatives. The first step in preparing an EIS is to determine the scope of the project, and its range of actions, alternatives and impacts to be included in the document.

The Council on Environmental Quality regulations (40 *CFR*, Parts 1500-1508), require that agencies responsible for preparing an EIS use an early scoping process to determine the significant issues related to the *Proposed Action* and the alternatives which should be addressed in the EIS. The principal purpose of the scoping process is to identify important issues, concerns and potential impacts which require detailed analyses in the EIS and to eliminate insignificant issues and alternatives from detailed analyses. Scoping thus serves to make the EIS process more efficient by reducing paperwork and analysis of inconsequential issues. Scoping allows the EIS to concentrate on relevant concerns.

The scoping process for the Amoco *CO_2* Projects consisted of agency meetings and five separate public scoping meetings held throughout the project area. With the assistance of federal and state agencies, local governments and private individuals, the significant issues and concerns were identified for analysis in the EIS. Insignificant issues were also discussed so that they could be eliminated from the scope of the EIS.

The public scoping meetings were publicized within the affected area through newspapers, radio and television. Information regarding the project and the Bureau's intent to prepare an environmental impact statement was published in the October 17, 1987, Federal Register (52 FR 38817).

Responses to the scoping notices and meetings were accepted through December 30, 1987. Later comments were also incorporated into the scoping analysis. Interested individuals, groups and local agencies were given the opportunity to voice their concerns and raise issues which they felt required consideration in the EIS.

Identification and Summary of Issues

Issues to be considered in the EIS were identified by the public and various federal and state agencies and local governments. The majority of the questions received during public scoping dealt with the design and implementation of CO_2 flooding and its applicability to other fields located in Wyoming. Other concerns were expressed by state agencies in written comments regarding potential impacts to the environment, in particular impacts to aquatic and terrestrial components. Questions about practices Amoco would utilize to maximize the hiring of Wyoming residents and the residency patterns of the *workforce* were raised by several members of the general public and state agencies. The concerns expressed in both meetings and letters are summarized in Table 6-1.

6.3 CONSULTATION AND COORDINATION

While preparing the draft EIS, the *BLM* and their third party contractor consulted with many federal, state and local agencies and organizations. See Appendix 2 for correspondence relating to consultation with the U.S. Fish and Wildlife Service regarding

Table 6-1. Issues Raised During Public Scoping for the Amoco CO2 Projects.

Issue	General Public	Industry	Federal Agencies	State Agencies	County/Local Governments
Air quality impacts from the development and operation of the Raptor Unit	X	X	X	X	X
Proper disposal of all process-related solid industrial and hazardous wastes				X	
Characterization of all process-related solid industrial and hazardous wastes				X	
Possible deterioration of water quality as a result of acidic deposition			X	X	
Restriction of the length of time that sediment levels are elevated in a disturbed stream				X	
Potential impacts of injection of carbon dioxide on ground and surface water quality	X			X	
Adequate protection of pipeline against surface disturbance and damage that could result in a spill event				X	
Placement of block valves at all live stream crossings on either side of the stream				X	
Placement of block valves on both sides of any drainage basin crossed within ten miles of any Class 1 or Class 2 stream				X	
Use of non-streambed fill free of fines at river backfills				X	
Stabilizing disturbed stream banks with rip rap and appropriate plant varieties				X	

Table 6-1. Continued.

Issue	General Public	Industry	Federal Agencies	State Agencies	County/Local Governments
Excluding petroleum containers, car bodies, metal refuse and similar items for streambank protection				X	
Minimizing in-stream work				X	
Using only rubber-tired equipment for in-stream construction				X	
Prohibiting in-stream construction during the spring and fall trout spawning and incubation periods				X	
Quantify potential habitat losses for various alternatives				X	
Provide specific measures to minimize disturbance to wildlife and their habitats				X	
Propose specific mitigation measures to replace disturbed habitat (particularly habitat quality)				X	
Identify measures taken in the event of an accidental leak				X	
Sensitive habitat avoidance				X	
Seasonal restrictions to protect wildlife				X	
Contractors restrict free ranging dogs on construction sites				X	
Evaluate impacts to big game on crucial winter range during drilling and pipeline work				X	
Evaluate short- and long-term loss of habitat within big game crucial winter range (well pads, pipeline routes and roads)				X	

Table 6-1. Continued.

Issue	General Public	Industry	Federal Agencies	State Agencies	County/Local Governments
Evaluate disturbances of, or habitat alteration on, sage grouse breeding complexes and wintering areas				X	
Evaluate disturbances which could impact black-footed ferrets or burrowing owls				X	
Evaluate impacts to nesting raptors and/or loss of nest sites				X	
Evaluate impacts of power line construction, especially across or along water courses and lakes or ponds which may cause loss of bald eagles, hawks, sandhill cranes and whooping cranes				X	
Evaluate disturbances which could impact bald eagle winter roosting habitats				X	
Evaluate impacts to riparian and wetlands habitats				X	
Evaluate impacts of projects on ephemeral stream dewatering				X	
Discuss pipeline monitoring and leak detection for pipelines				X	
Evaluate long-term and cumulative impacts for the Fontenelle gas plant and wellfield				X	
Mitigation should be required for all local serious impacts				X	
Disturbed areas should be revegetated as soon as possible with native species, particularly on crucial winter ranges and riparian habitats				X	

Table 6-1. Continued.

Issue	General Public	Industry	Federal Agencies	State Agencies	County/Local Governments
Consideration should be given to non-vegetative habitat components such as soils, topography and water availability				X	
Prairie dog town surveys, raptor nest surveys and sage grouse distribution surveys should be initiated at least two years ahead of the planned project start-up				X	
Winter inventory work should include sage grouse winter distribution, prairie dog town mapping and black-footed ferret searches. Spring/Summer inventory work should include searches for sage grouse leks and raptor nests.				X	
Evaluate all possible alternatives, including purchase of carbon dioxide from Exxon's Shute Creek Plant	X	X	X	X	X
Construction activities and possible impacts to state roads and other existing roads			X	X	
Impacts of oversize loads associated with project equipment on state roads				X	
Permits necessary from State Engineer's Office for water use				X	
Characteristics of accidental pipeline ruptures				X	
Gas plant emission estimates and cumulative impacts from other sources in the area	X		X	X	X
Scenarios for possible release of carbon dioxide to the atmosphere		X		X	

Table 6-1. Continued.

Issue	General Public	Industry	Federal Agencies	State Agencies	County/Local Governments
Possible enrichment of hydrogen sulfide in the reservoirs and implications for safety and resources		X		X	
Estimates of total disturbance from field-related construction	X				
Nature of the sealed system used to produce and inject carbon dioxide	X				
Number of workers needed for construction, including residency patterns by project and an estimate of permanent and temporary workers					X
Criteria used to select a reservoir for carbon dioxide-enhanced oil recovery	X	X			
Methods used to maximize Wyoming residents in the workforce	X				X
Use brush beating and minimum blading where possible			X		

species protected under the Endangered Species Act. Agencies and individuals that participated in the scoping process are listed below:

Federal Agencies

Advisory Council on Historic Preservation
Army Corps of Engineers
Bureau of Indian Affairs
Bureau of Reclamation
Fish and Wildlife Service
Forest Service
National Park Service
Soil Conservation Service

State of Wyoming

Department of Administration and Fiscal Control
Department of Environmental Quality
Department of Geography and Recreation, University of Wyoming
Economic Development and Stabilization Board
Employment Security Commission
Game and Fish Department
Highway Department
Industrial Siting Administration
Institute for Policy Research
Job Service of Wyoming
Public Service Commission
Senator Simpson's Office
Senator Wallop's Office
State Archives, Museums and Historical Dept. Historical Research Division
State Engineer's Office
State Historical Preservation Office
State Legislature
University of Wyoming American Heritage Center; Coe Library

Other States

Colorado Division of Wildlife
Montana Department of Fish, Wildlife and Parks, Billings Office
Montana Department of Fish, Wildlife and Parks, Bozeman Office

Local Governments/Organizations

Big Horn County
Big Horn County Attorney
Big Horn County School District No. 1
Casper Board of Realtors
Casper Chamber of Commerce
Casper Motel and Hotel Owners Association
Castle Rock Medical Clinic and Castle Rock Hospital District (Green River)
City of Cody
City of Green River
City of Kemmerer
City of Powell
City of Riverton
City of Rock Springs
City of Worland
Cody Chamber of Commerce
Cody Job Service Center
Eden-Farson Fire Control District
Elk Basin Water Users Association
Farmer's Canal Company
Fremont County
Fremont County Fire Fighters
Fremont County School District No. 1
Fremont County School District No. 25
Fremont County Solid Waste Disposal District
Green River Chamber of Commerce
Hot Springs County

Hot Springs County School District No. 1, Thermopolis
Hot Springs School District #1
Hot Springs Hospital
Kemmerer
Kemmerer Area Chamber of Commerce
Kemmerer Job Service Center
Kemmerer Volunteer Fire Dept/ S. Lincoln Fire Protection District
Lander Job Service Center
Lander Motel Association
Lincoln County
Lincoln County School District No. 1
Memorial Hospital (Rock Springs/ Green River area)
Midwest School District
Natrona County
Natrona County School District No. 1
Park County
Park County Fire District No. 2, Cody
Park County Fire Protection District No. 1, Powell
Park County School District No. 1 (Powell)
Park County School District No. 6
Park County School District No. 16
Postmaster, Unincorp. Town of Farson
Powell Hospital and Nursing Home, Powell
Powell Recreation District
Riverton Chamber of Commerce
Riverton Fire Protection District
Riverton Job Service Center
Rock Springs Chamber of Commerce
Shoshone - Heart Mountain Irrigation District
S. Lincoln County Hospital Dist./ S. Lincoln Medical Center
Sweetwater County
Sweetwater County School District No. 2
Town of Deaver
Town of Diamondville
Town of Edgerton
Town of Frannie
Town of Granger
Town of LaBarge
Town of Meeteetse
Town of Midwest
Town of Opal
Town of Thermopolis
Washakie County
Washakie County School District No. 1
Washakie Memorial Hospital
West Park Hospital, Cody
Willwood Irrigation District
Worland Fire Protection District
Worland Job Service Center
Wyoming Medical Center

Citizen Groups and Regional Societies

Oregon-California Trail Association
Rocky Mountain Heritage Task Force
Wind River Multiple Users
Wyoming Outdoor Council

Industry/Business

Amoco Pipeline Company
Amoco Production Company
Caldwell Realty, Cody
Carl Weissman & Sons
CMS Realty, Rock Springs
Dale Crank, Engineering Consultant
Daniel's Mobile Home
Doubletree Agency, Worland
Eagleton Engineering
Econ Inc.
Edgerton Service & Equipment Company
Engineering Association
ERA Aspen Realty Inc., Riverton
Exxon Pipeline Company
Exxon Production, U.S.A.
Fontenelle Store
Geesey Real Estate Brokerage Inc., Diamondville
G.Q. Bower Co., Worland
Graham, Dietz and Associates
Hake Realty, Worland
HCA Riverton Hospital
Hilltop National Bank

Holiday Inn, Rock Springs
Holly Sugar
Hot Springs REA
Ingberg Miller Engineers
John Bunning Transfer
Kiewit
Mary P. Brooks, Realtor, Green River
Melin Realty, Worland
Memorial Hospital (Rock Springs/ Green River area)
Midway Liquors
Minter Realtors
Mobil
Mortimore Ambulance ServiceNew-Tex Supply Company
Northern Engineering & Testing, Inc.
Northwest Pipeline Company
Pacific Power and Light Company
Petroleum Association of Wyoming
Properties West Inc., Thermopolis
Riverton Valley Electric
RVEA
Sandy Crossing Ent.
Terra Resources
The Property Company, Casper
The Real Estate Brokerage, Worland
Tri-State
West Park Hospital, Cody
Williton Basin Pipeline Company
Wind River Realty, Riverton
WLC&J
World Oil & Gas
Wyo-West, Thermopolis

Document Availability

Copies of the draft EIS may be obtained from:

Bureau of Land Management
Attention: Glen Nebeker
Casper District Office
1701 E. E Street
Casper, Wyoming 82601
(307) 261-5101

The draft EIS will be available for public review during normal business hours and limited numbers of copies will be available for distribution at:

Bureau of Land Management
Miles City District Office
P.O. Box 940
Miles City, Montana 59301
(406) 232-4331

Bureau of Land Management
Wyoming State Office
P.O. Box 1828
2515 Warren Avenue
Cheyenne, Wyoming 82003
(307) 772-2425

Bureau of Land Management
Worland District Office
P.O. Box 119
101 S. 23rd Street Worland, Wyoming 82401
(307) 347-9871

Bureau of Land Management
Billings Resource Area
810 East Main
Billings, Montana 59105
(406) 657-6262

Bureau of Land Management
Rock Springs District Office
Highway 191 North
Rock Springs, Wyoming 82902
(307) 382-5350

Bureau of Land Management
Rawlins District Office
P.O. Box 670
1300 North 3rd Street
Rawlins, Wyoming 82301
(307) 324-7171

REFERENCES

Affinis. 1986. Elk Basin baseline studies, Unpublished report for Amoco Production Company. 29p.

American Conference of Governmental Industrial Hygienist. 1987-1988. Threshold Limit Values for Chemical Substances and Physical Agents in the Workroom Environment. ACGIH. Cincinnati, Ohio.

Amoco Production Company. 1987. Submission to Wyoming Department of Environmental Quality Air Quality Division regarding permit for new construction of a gas plant in the Salt Creek Field.

Arnold, S. 1988. Soil Conservation Service. Telephone Conversation with Planning Information Corporation in reference to cultivation in the Salt Creek Project area. January 12.

Baldwin, Dr. Mel, Assistant Superintendent in Charge of Finance and Business, Fremont County School District No. 25. 1987. Interview with Planning Information Corporation regarding school system, staffing and enrollment, 19 November.

Barfield, B. J., R. C. Warner and C. T. Haan. 1987. Applied Hydrology and Sedimentology for Disturbed Areas. Oklahoma Technical Press. 602p.

Basko, D., Wyoming Oil and Gas Conservation Commission. 1987. Letter to Bureau of Land Management regarding Amoco CO_2 Projects, 18 December.

Benton, Mark, Sheriff, Natrona County. 1987. Telephone conversation with Planning Information Corporation regarding law enforcement staffing and facilities, 28 December.

Bole, Bob, Broker, Caldwell Realty, Cody. 1987. Telephone conversation with Planning Information Corporation regarding housing availability in Park County, 9 December.

Bole, Bob, Broker, Caldwell Realty, Cody. 1988. Telephone conversation with Planning Information Corporation regarding housing availability, 19 January.

Bott, Allen, Assistant Land Specialist, Wyoming Game and Fish Department. 1988. Telephone conversation with Planning Information Corporation regarding fishing access at proposed Elk Basin Pipeline Shoshone River crossing.

Bryan, L. 1987. Testimony Presented to the Wyoming Oil and Gas Conservation Commission. Docket No. 312-87. November 10, 1987.

Bureau of the Census. 1982. 1980 Census of Housing, Vol. 1, Characteristics of Housing Units. Chapter A, General Housing Characteristics, Part 52, Wyoming.

Bureau of Land Management. 1978. Sandy Grazing Final Environmental Statement.

Bureau of Land Management. 1982a. Frontier Pipeline Company Crude Oil and Condensate Pipeline Draft Environmental Impact Statement. (Document finalized February 1983)

Bureau of Land Management. 1982b. Grass Creek Grazing Draft Environmental Impact Statement, Worland District. (Document finalized September 1982)

Bureau of Land Management. 1982c. Green Mountain Draft Grazing Environmental Impact Statement, Rawlins District. (Document finalized 1988)

Bureau of Land Management. 1982d. Lombard Allotment Management Plan. Green River Resource Area files.

Bureau of Land Management. 1983a. Eighteen-Mile Allotment Management Plan. Green River Resource Area files.

Bureau of Land Management. 1983b. Salt Wells-Pilot Butte area, Proposed Grazing Management Program, Draft Environmental Impact Statement, Rock Springs District. (Document finalized 1984)

Bureau of Land Management. 1983c. Riley Ridge Natural Gas Project. Draft Environmental Impact Statement. (Document finalized November 1984)

Bureau of Land Management. 1983d. Riley Ridge Natural Gas Project, Draft Environmental Impact Statement: Air Quality Technical Report.

Bureau of Land Management. 1983e. Wyoming wilderness status map.

Bureau of Land Management. 1983f. Riley Ridge Natural Gas Project, Draft Environmental Impact Statement: Cultural Resources Technical Report.

Bureau of Land Management 1983g. Billings Resource Area Resource Management Plan, Final Environmental Impact Statement.

Bureau of Land Management. 1984a. Platte River Resource Area Resource Management Plan, Draft Environmental Impact Statement, Casper District. (Document finalized November 1984)

Bureau of Land Management. 1984b. Rangely CO_2 Pipeline, Draft Environmental Impact Statement. (Document finalized February 1985)

Bureau of Land Management. 1984c. Platte River Resource area, Resource Management Plan/Final Environmental Impact Statement, Casper District. Supporting data may be found in draft)

Bureau of Land Management. 1984d. Wilderness status map.

Bureau of Land Management. 1985a. Draft Environmental Impact Statement on the Baroil/Dakota Carbon Dioxide Projects. Cheyenne, Wyoming. 252 pp. (Document finalized February 1986)

Bureau of Land Management. 1985b. Kemmerer Resource Management Plan, Draft Environmental Impact Statement, 315 pp. (Document finalized 1985)

Bureau of Land Management. 1986a. Lander Grazing Supplement, Final Environmental Impact Statement.

Bureau of Land Management. 1986b. Lander Resource Management Plan, Final Environmental Impact Statement, Rawlins District.

Bureau of Land Management. 1986c. Washakie Resource Area, Resource Management Plan, Draft Environmental Impact Statement, Worland District. (Document finalized September 1987)

Bureau of Land Management. 1986d. Visual Resource Contrast Rating. BLM Manual Handbook 8431-1.

Bureau of Land Management. 1986e. Kemmerer Resource Management Plan Final Environmental Impact

Statement and Record of Decision. (Supporting data may be found in draft)

Bureau of Land Management. 1986f. Oregon/Mormon Pioneer National Historic Trails Management Plan.

Bureau of Land Management. 1986g. State of Wyoming Wilderness Status map; 1:1,000,000.

Bureau of Land Management. 1986h. Washakie Resource area, Wilderness Supplement to Resource Management Plan/Draft Environmental Impact Statement. (Document finalized 1987)

Bureau of Land Management. 1986i. Exxon LaBarge Project Environmental Impact Statement. Record of Decision.

Bureau of Land Management. 1987a. Riparian area management. U.S. Government Printing Office 175-814. 4 p.

Bureau of Land Management. 1987b. Washakie Resource Management Plan, Final Environmental Impact Statement, Worland District.

Bureau of Land Management. 1987c. Grass Creek/Cody Resource areas, Wilderness Suitability Environmental Impact Statement/ Preliminary Final, Worland District.

Bureau of Land Management. 1987d. Pinedale Resource Management Plan Final Environmental Impact Statement.

Bureau of Land Management. 1988. Cody Resource Area, Resource Management Plan/Draft Environmental Impact Statement, Worland District. (Document finalized September 1988)

Bureau of Land Management. Not Dated. Wyoming existing district and resource area boundaries [map].

Bureau of Reclamation. 1972. Shoshone Project Map No 26-600-400. U.S. Government Printing Office 1980-777-458.

Bureau of Reclamation. 1977. Fontenelle Recreation Master Plan.

Calder, J., Amoco Production Company. 1988. Conversation with Planning Information Corporation.

Call, M. W. 1978. Nesting habitats and surveying techniques for common western raptors. U.S. Department of the Interior, Bureau of Land Management, Tech. Note No. IN-316. Denver Federal Center.

Case, J. C., C. S. Boyd, W. B. Murray and K. L. Piwoschuk. 1984. Preliminary map of landslides and windblown sand deposits of the Lander 1° x 2° Topographic Map. Geological Survey of Wyoming, Open File Report 84-5.

Casper Area Chamber of Commerce, Casper Parks and Recreation and Wyoming Travel Commission. Not Dated. Casper recreation indoors and out [pamphlet].

Casper Star-Tribune. 1988. Classified listings for housing types, 17 January.

Chaffin, Everett, Mayor, Town of Midwest. 1987. Interview with Planning Information Corporation regarding housing, population, fire protection, emergency medical, water and sewer systems and law enforcement, 2 November.

Charles, J., Bureau of Indian Affairs 1988. Telephone conversations with Planning Information Corporation. July-August.

Christiensen, Laurie. 1987. Telephone conversation with Planning

Information Corporation regarding recreation history, plans for Fontenelle reservoir.

City of Green River. Not Dated. Public Works facility [brochure].

Clark, Tim W., and Mark R. Stromberg. 1987. Mammals in Wyoming. University of Kansas Museum of Natural History. Lawrence, Kansas. 314 pp.

Coates, Wayne, Superintendent, Fremont County School District No. 1. 1987. Telephone conversation with Planning Information Corporation regarding school system, staffing and enrollment, 28 December.

Code of Federal Regulations, Title 36. Pertaining to the National Historic Preservation Act of 1966.

Cooper, C., Water Superintendent, State Engineers Office. 1988. Telephone conversation with Planning Information Corporation. January 20.

Crow, P. 1988. Pipeline safety bills, drug test proposals gain ground in U.S. Oil and Gas Journal, July 25: 23-26.

Dennis, Rose, President, Casper Board of Realtors. 1988. Telephone conversation with Planning Information Corporation regarding housing availability, 11 January.

Dillahunty C., Bureau of Indian Affairs. 1988. Conversations with Planning Information Corporation. June.

Exxon. 1985. LaBarge Project Permit Application for Phase II. Wyoming Industrial Siting Council.

Exxon. 1986. LaBarge Project. Socioeconomic Monitoring Report, Second Quarter, 1986. Prepared by Planning Information Corporation, Denver, Colorado.

Exxon. 1987. Exxon LaBarge Project: Phase I critique session (unpublished).

Ferrari, David G., Ruth C. Sommers and Janet E. Washburn. 1988. Joint Legislative-Executive Committee Wyoming 1988: A Study of Revenue and Expenditures. 3 vol.

Fifield, C., Bureau of Land Management, Platte River Resource Area. 1988. Telephone conversation with Planning Information Corporation. January, 8.

Glass, Gary B. and D. L. Blackstone, Jr. 1987. Geology of Wyoming. The Geological Survey of Wyoming, Laramie.

Green River Chamber of Commerce. Not Dated. Community Service Guide. Brochure.

Green River Chamber of Commerce. Not Dated. Listing of services and business. Pamphlet.

Hall, Gary, Vice President of Professional Services, Wyoming Medical Center. 1988. Telephone conversation with Planning Information Corporation regarding hospital and emergency medical staffing, 4 January.

Hatch, Kim R., Secretary, Engineering, City of Green River. 1987. Letter to Planning Information Corporation regarding changes in housing supply since 1980, 17 November.

Hausel, W. Dan, Gary B. Glass, David R. Lageson, Alan J. Ver Ploeg, and Rodney H. De Bruin, compilers. 1979. Wyoming Mines

and Minerals. The Geological Survey of Wyoming, Laramie.

Hawley, Dawn, Director, Riverton Chamber of Commerce. 1987. Telephone conversation with Planning Information Corporation regarding motel availability, 4 December.

Hodge, Dan, Sheriff, Park County. 1987. Interview with Planning Information Corporation regarding law enforcement staffing and facilities, 5 November.

Hopkins, B., Elk Water Users Association. 1988. Telephone conversation with Planning Information Corporation regarding irrigation districts. January 19.

Hoyt, M., Farmer's Canal Company. 1988. Telephone conversation with Planning Information Corporation regarding irrigation. January 20.

James, L. F. and R. F. Kaller. 1980. Plants poisonous to Livestock in the Western United States. U.S. Department of Agriculture, Agriculture Information Bulletin No. 415.

Johnson, H. R. 1982. Outlook for Enhanced oil Recovery. DOE internal report, Bartlesville, Okla.

Johnson, Janet L, and Robert D. Pfister. 1982. A Survey of Potential Ecological Natural Landmarks of the Middle Rocky Mountains. Intermountain Forest and Range Experiment Station, U.S.D.A. Forest Service, Ogden, Utah.

Kaul, R. B. 1986. Physical and floristic characteristics of the Great Plains. In: R. L. McGregor, Coordinator, Flora of the Great Plains. University Press of Kansas.

Klins, M. A. 1984. Carbon Dioxide Flooding, Basic Mechanisms and Project Design. International Human Resources Development Corporation, Boston.

Knight, Dennis H., Robert J. Hill and A. Tyrone Harrison. 1976. Potential Natural Landmarks in the Wyoming Basin: Terrestrial and aquatic ecosystems. Department of Botany, University of Wyoming.

Latimer, D. A. and R. G. Ireson. 1980. Workbook for estimating visibility impairment. EPA-450/4-80-031. U.S. Environmental Protection Agency, Research Triangle Park, NC.

Lawrence, Karla, Secretary, Fremont County Road and Bridge Department. 1988. Letter to Planning Information Corporation regarding Road and Bridge Department facilities, 14 January.

LeBarron, William W., Area Manager, Green River Resource Area, BLM. 1988. Letter to Planning Information Corporation regarding utility corridors, 29 April.

Lutterman, Ray, General Commissioner, City of Powell. 1988. Telephone conversation with Planning Information Corporation regarding population estimates, 25 January.

Marriott, H., Rocky Mountain Heritage Task Force. 1987. Communications with Planning Information Corporation after consultation with Rocky Mountain Herbarium personnel regarding sp. nov. *Astragalus jejunus* and *Cleome multicaulis*.

McCoy, Joanne, Town Clerk, Town of Edgerton. 1987. Interview with Planning Information Corporation regarding population and housing, 2 November.

McGrew, Paul O., T. M. Bown, M. W. Hager and B. Mears. 1974. Inventory of significant geological areas in the Wyoming Basin Natural Region. Department of Geology, University of Wyoming, Laramie, Wyoming. 2 vol.

Miller, J. A. and R. A. Jones. 1981. A Laboratory Study to Determine Physical Characteristics of Heavy Oil after CO_2 Saturation. Paper SPE 9789 presented at the 2nd Joint SPE/DOE Symposium on Enhanced Oil Recovery. Tulsa, Oklahoma. April 5-8, 1981.

National Oceanic and Atmospheric Administration. 1985. Climatological data annual summary, Wyoming. 1985. Department of Commerce.

National Park Service. 1982. The Nationwide Rivers Inventory.

National Park Service. 1987. Computer print-out, Designated and Potential National Natural Landmarks in Wyoming and Montana.

Nicol, Alma, County Clerk, Fremont County. 1988. Letter to Planning Information Corporation regarding Fremont County government staffing and facilities, 14 January.

Occupational Safety and Health Act. 1987. 29 CFR 1910.1000. January.

O'Donnell, Mike. 1987. Telephone conversation with Planning Information Corporation regarding information on recreation user days at Fontenelle Reservoir.

Olendorff, R. R., A. Miller and R. Lehman. 1981. Suggested practices for raptor protection on power lines. The state of the art in 1981. Raptor Research Report No. 4. Raptor Research Foundation, Inc. Department of Vet. Biology. University of Minnesota, St. Paul.

Paine, L., Under-Sheriff, Sweetwater County. 1987. Telephone conversation with Planning Information Corporation regarding law enforcement and search and rescue services staffing and facilities, 24 November.

Patterson, Maxine, Mayor, Town of Edgerton. 1987a. Interview with Planning Information Corporation regarding Edgerton law enforcement, fire protection, water and sewer systems, economy, housing, roads and recreation, 2 November.

Patterson, Maxine, Mayor, Town of Edgerton. 1987b. Telephone conversation with Planning Information Corporation regarding parks and recreation facilities, 9 November.

Payne, Glenn, Planner, Planning Department, City of Casper. 1987. Telephone conversation with Planning Information Corporation regarding local population estimates and projections, 25 January.

Planning Information Corporation. 1988. Informal survey.

Powell Tribune. 1987. Twice-weekly newspaper. 5 November.

Powers Elevation. 1988a. Cultural Resource Management Report: A Class I cultural resources literature review for the proposed Amoco Beaver Creek Unit and proposed CO_2 pipeline project.

Powers Elevation. 1988b. Cultural Resource Management Report: A Class I cultural resources literature review for the proposed Amoco Little Buffalo Basin Unit and proposed CO_2 pipeline project.

Powers Elevation. 1988c. Cultural Resource Management Report: A Class I cultural resources literature review for the proposed Amoco Raptor Unit and proposed CO_2 pipeline project.

Powers Elevation. 1988d. Cultural Resource Management Report: A Class I cultural resources literature review for the proposed Amoco Salt Creek Unit and proposed CO_2 pipeline project.

Powers Elevation. 1988e. Cultural Resource Management Report: A Class III cultural resources inventory of the Amoco Elk Basin CO_2 Pipeline, Wyoming, Vol. 1: Draft Narrative Report.

Price, Raymond E., Director, Planning Department, Fremont County. 1987. Interview with Planning Information Corporation regarding housing, economic development, population estimates and Indian reservation tax situation, 19 November.

Pullman-Kellogg, Inc. 1978. Sources and Delivery of Carbon Dioxide for Enhanced Oil Recovery. U.S. Department of Energy FE-2515-24. Bartlesville, Okla.

Ratliff, Jack, Realtor, Wind River Realty, Riverton. 1988. Telephone conversation with Planning Information Corporation regarding housing availability, 19 January.

Rhodes, T., Water Commissioner, Water Division 3, State of Wyoming. 1988. Telephone conversation with Planning Information Corporation. January, 7.

Ribble, George D., Assistant Superintendent, Park County School District No. 1 (Powell). 1987. Interview with Planning Information Corporation regarding school system, staffing and enrollment, 5 November.

Rigby, J. Keith. 1981. Proposed Natural Landmarks of the Middle Rocky Mountains: Geologic themes.

Roseberry, J., Bureau of Land Management, Worland. 1988. Telephone conversation with Planning Information Corporation. January, 7.

Salazar, Kaye, National Park Service. 1988. Telephone conversation with Planning Information Corporation regarding National Natural Landmark status of Crooks Gap and Atlantic City Goldfield, 21 April.

Shoshone - Heart Mountain Irrigation District. 1988. Telephone conversation with Planning Information Corporation. January 19.

Shultz, L., Curator, Intermountain Herbarium. 1987. Telephone conversation with Planning Information Corporation regarding sp. nov. *Astragalus jejunus*.

Sittig, M. 1981. Handbook of Toxic and Hazardous Chemicals. Noyes Publications, Park Ridge, New Jersey.

Soil Conservation Service. 1970. Precipitation zones for technical range site descriptions, map.

Soil Conservation Service. 1975. General Soils map of Wyoming.

Soil Conservation Service. 1982. General Soils map of Sweetwater County.

Soil Conservation Service. 1983a. Prime farmland soil map units by counties, Wyoming. Unpublished list.

Soil Conservation Service. 1983b. Wyoming average annual precipitation. Map scale 1:1,000,000.

Soil Conservation Service. 1985. General Soils map of Natrona County.

Soil Conservation Service. 1986. Range site descriptions. Technical Guide Section II E.

Stephenson, T. R., A. J. Ver Ploeg and L. S. Chamberlain. 1984. Oil and gas map of Wyoming; 1:500,000. Geological Survey of Wyoming.

Stoddard, L. A., S. D. Smith and T. W. Box. 1975. Range management. Third edition. McGraw-Hill Book Company. New York.

Sullivan, Jim, Fire Chief, Natrona County Fire Department. 1987. Telephone conversation with Planning Information Corporation regarding fire protection staffing and facilities, 28 December.

Sweetwater County Planning Department. 1987. Sweetwater County, Quarterly No. 16.

Thompson, C., Holly Sugar, Agricultural Department. 1988. Telephone conversation with Planning Information Corporation regarding beet truck traffic. January, 7.

Thorne, K. Brigham Young University Herbarium. 1987. Telephone conversation with Planning Information Corporation regarding sp. nov. *Astragalus jejunus*.

U.S.D.A. Forest Service. 1986. 1986 ROS book.

U.S. Fish and Wildlife Service. 1973. Seedskadee National Wildlife Refuge.

U.S. Fish and Wildlife Service. 1982. Seedskadee National Wildlife Refuge.

U.S. Geological Survey. 1978-1987. Water resource data, Wyoming. Cheyenne, Wyoming.

Watt, Dennis L., Planning Director, Sweetwater County. 1988. Telephone conversation with Planning Information Corporation regarding DAFC and locally prepared population estimates and projections for Sweetwater County and municipalities. 1 January and 3 February.

Welch, Darrell. 1988. Telephone conversation with Planning Information Corporation regarding Fontenelle land use plan status.

White, Joe, Chief of Fisheries Branch, Wyoming Game and Fish Department. 1987. Telephone conversation with Planning Information Corporation regarding definitions of terms used in 1986 Annual Report. 28 October.

Whitson, T. D. 1987. Weeds and Poisonous Plants of Wyoming and Utah. Cooperative Extension Service, University of Wyoming.

Willwood Irrigation District. 1988. Telephone conversation with Planning Information Corporation. January 19.

Windell, J. T., B. E. Willard, D. J. Cooper, S. Q. Foster, C. F. Knud-Hansen, L. P. Rink and G. N. Kiladis. 1986. An ecological characterization of Rocky Mountain montane and subalpine wetlands. Biological Report 86(1). U.S. Fish and Wildlife Service. 298p.

Winward, A. H. 1980. Taxonomy and Ecology of Sagebrush in Oregon. Station Bulletin 642. Agricul-

tural Experiment Station, Oregon State University, Corvallis.

Winward, A. H. and E. W. Tisdale. 1969. A simplified chemical method for sagebrush identification. Forest, Wildlife and Range Experiment Station Note No. 11. University of Idaho.

Woodward-Clyde Consultants. 1985. Cultural and paleontological investigations along the Chevron carbon dioxide and phosphate slurry pipeline corridors.

Wyoming Agricultural Statistics Service. 1986. Wyoming Agricultural Statistics, 1986.

Wyoming Census Retrieval and Information Service. 1981. Report #5.

Wyoming Department of Administration and Fiscal Control, Division of Research and Statistics. 1983. Wyoming Population and Employment Forecast Report. 6th ed.

Wyoming Department of Administration and Fiscal Control, Division of Research and Statistics. 1988 Final Employment Matrix and Final Population Matrix.

Wyoming Economic Development and Stabilization Board. 1986a. Community Business/Industrial Index, Powell Wyoming.

Wyoming Economic Development and Stabilization Board. 1986b. Community Business/Industrial Index, Riverton, Wyoming.

Wyoming Game and Fish Department. 1987a. Annual report of big game; Harvest, 1986.

Wyoming Game and Fish Department. 1987b. 1987 annual report.

Wyoming Game and Fish Department. 1987c. 1987 Wyoming Elk, Deer and Antelope Areas (maps).

Wyoming Game and Fish Department. 1987d. No title; list of hunt areas and herd units, updated 5/87.

Wyoming Game and Fish Department. 1987e. Wyoming trout stream classification map.

Wyoming Recreation Commission. 1985. State comprehensive outdoor recreation plan: Wyoming 1985 Technical Document.

Wyoming Recreation Commission. 1987a. Bairoil survey regional recreation monitoring program summary results.

Wyoming Recreation Commission. Not Dated(a). Boysen State Park map.

Yetter, Nea, Town Clerk, Town of Meeteetse. 1987. Interview with Planning Information Corporation regarding population, government administration and water and wastewater systems, 6 November.

Yetter, Nea, Town Clerk, Town of Meeteetse. 1988. Telephone conversation with Planning Information Corporation regarding housing availability, 19 January.

Zachness, Kurt, Superintendent, Gene Carmody, Assistant Superintendent, and Bob Arnold, Business Manager, Sweetwater County School District No. 2. 1987. Interview with Planning Information Corporation regarding school system, staffing and enrollment, 16 November.

GLOSSARY, ACRONYMS AND ABBREVIATIONS

ANSI--American National Standards Institute.

API--American Petroleum Institute.

ASME--American Society of Mechanical Engineers.

ANSI/ASME--Type A and C construction standards are for class location unit areas 1 and 3. Location 1 is any area with less than ten buildings intended for human occupancy in a one-mile section of pipeline extending 220 yards on either side of the pipeline. Location 3 is any area having 46 or more buildings intended for human occupancy. Type A and C construction standards for class 1 and 3 location areas are .75 and .50 percent of the specified minimum yield strength, respectively.

AUMs--Animal unit months.

BCF--Billion cubic feet.

BLM--Bureau of Land Management.

CFR--Code of Federal Regulations.

CO_2--Carbon Dioxide.

Corridor--For purposes of this environmental impact statement, a wide strip of land within which a proposed linear facility could be located.

Cow-Calf Livestock Operation--A livestock operation in which a base breeding herd of mother cows and bulls is maintained. The cows produce a calf crop each year, and the operation keeps some heifer calves from each calf crop for breeding herd replacements. The operation sells the rest of the calf crop between the ages of 6 and 12 months along with old or nonproductive cows and bulls.

Crucial Habitat--An area that is essential to the survival of any wildlife species sometime during its life cycle.

Cultural Resource Inventory Classes:

Class I--Existing data inventory: an inventory study of a defined area designed (1) to provide a narrative overview (cultural resource overview) derived from existing cultural resource information and (2) to provide a compilation of existing cultural resource site record data on which to base the development of the BLM's site record system.

Class III--An intensive field inventory designed to locate and record, from surface and exposed profile indications, all cultural resource sites within a specified area. After Class III inventories are completed in an area, no further cultural resource inventory work is normally needed. A Class III inventory is appropriate on small project areas, all areas to be disturbed and primary cultural resource areas.

Cumulative Impacts--Impacts that would occur as a result of the proposed location(s) plus interrelated projects whose impacts would occur in the same time or space.

DAFC--Wyoming Department of Administration and Fiscal Control.

Debitage--Waste flakes from tool making activities.

DEIS--Draft Environmental Impact Statement.

Displacement Efficiency--Ability to displace oil in reservoir for recovery.

Dissolution--Breaking up or dissolving, disintegration.

Emission--Effluent discharge into the atmosphere, usually specified by mass per unit time.

Endangered Species--Any animal or plant species in danger of extinction throughout all or a significant portion of its range.

Enhanced Oil Recovery--Any enhanced recovery of oil undertaken after secondary operations. Since enhanced oil recovery usually follows waterflooding, enhanced oil recovery generally is considered among the more exotic oil recovery processes such as miscible displacement, thermal recovery or chemical flooding.

Ephemeral Stream--A stream that flows only in direct response to precipitation.

FEIS--Final Environmental Impact Statement.

FIRE--U.S. Bureau of Economic Analysis abbreviation for Finance, Insurance and Real Estate.

Floodplain--The flat ground along a stream which is covered by water when the stream overflows its banks at flood stages.

Forage--All browse and herbaceous foods available to grazing animals, which may be grazed or harvested for feeding.

Fossil--Any remains, trace or imprint of a plant or animal that has been preserved by natural processes in the earth's crust since some past geologic time.

Fugitive Dust--Airborne particles emitted from any source other than through a stack.

FY--Fiscal year.

Gravity Segregation--Separation of gas or liquids by the differences in their specific gravities.

H_2S--Hydrogen Sulfide.

Habitat--A specific set of physical conditions that surround the single species, a group of species, or a large community. In wildlife management, the major components of habitat are considered to be food, water, cover and living space.

Historic--Archaeological and archivally known sites related to the activities of non-native peoples, whether they be of Euro-American, Afro-American or Asian-American origin, in the period after the European discovery of the New World (ca. A.D. 1492).

IDLH--Immediately dangerous to life or health.

Immiscibility--The inability of two or more liquids to form a uniform blend or mixture or to dissolve in each other.

Impact--The change from an existing condition (baseline) caused by an action (such as construction or operation of a pipeline or facilities).

Increments--Maximum allowable increases over baseline concentrations of pollutants covered by the Prevention of Significant Deterioration (PSD) provisions in Class I, II, and III areas.

Injectivity--Increases in permeability of reservoir rock from dissolution of carbonate materials.

Immigrant--Individual who moves into the project area from another part of the country.

Intermittent Stream--A stream which flows part of the time, as after

a rainstorm, during wet weather periods, or during part of the year.

Lek--An area where grouse gather for ritualistic display and breeding; also, a sage grouse strutting ground.

Level C--See ANSI/ASME.

Level Of Service--In transportation studies, a qualitative measure of traffic flow along a given road consideration of a variety of factors, including speed and travel time, traffic interruptions and freedom to maneuver. Levels-of-service are designated A through F--A being a free-flow condition with low volumes at high speeds and F being a congested condition of low speeds and stop-and-go traffic. Intermediated levels describe conditions between these extremes. A level-of-service below C involves unstable to forced traffic flow in which a driver's freedom to select a speed is restricted and in which traffic stoppages cause congestion.

Lithic Scatter--A scatter of chipped stone materials which may include fragments, flakes or stone tools.

Loess--Material transported and deposited by wind and consisting of predominantly silt-sized particles.

MBO--Million barrels of oil.

Mesic--Adapted to a moist environment.

Miscibility--The tendency or capacity of two or more liquids to form a uniform blend, that is, to dissolve in each other.

Mitigation--The abatement or reduction of a construction or operation impact to the environment (1) avoiding a certain action or parts of an action, (2) employing certain construction measures to limit the degree of impact, (3) restoring an area to preconstruction conditions, (4) preserving or maintaining an area throughout the life of a project, (5) replacing or providing substitute resources to the environment, or (6) gathering archaeological and paleontological data before disturbance.

MMSCFD--Million standard cubic feet per day.

MSS--Manufacturer's Standardization Society.

NACE--National Association of Corrosion Engineers.

NAPC--National Association of Pipe Coating Applicators.

National Ambient Air Quality Standards (NAAQS)--The allowable concentrations of air pollutants in the air specified by the Federal Government in Title 40, Code of Federal Regulations, Part 50. The air quality standards are divided into primary standards (based on the air quality criteria and allowing an adequate margin of safety and requisite to protect the public health) and secondary standards (based on the air quality criteria and allowing an adequate margin of safety and requisite to protect the public welfare from any unknown or expected adverse effects of air pollutants). Welfare includes effects on soils, water, crops, vegetation, manufactured materials, animals, wildlife, weather, visibility and climate, damage to and deterioration of property, and hazards to transportation. Also included are effects on economic values and on personal comfort and well being.

National Natural Landmarks--Sites designated by the Secretary of the Interior as containing the best representative examples of geologic features and natural communities composing the nation's natural history. Purpose of the designation is to encourage preservation of such sites through well-informed management and use, and consideration of these

sites in public and private land use planning. Designation has no legal effect on land ownership, use or management (National Park Service, Not Dated, National Natural Landmark Designation).

NEPA--National Environmental Policy Act of 1969.

NGL--Natural gas liquids.

NOAA--National Oceanographic and Atmospheric Administration.

NPDES--National Pollution Discharge Elimination System.

NRHP--National Register of Historic Places.

Off-Road Vehicle (ORV)--A vehicle (including four-wheel drive, trail bikes and snowmobiles but excluding helicopters, fixed-wing aircraft and boats) capable of traveling offroad over land, water, ice, snow, sand, marshes and other terrain.

Original-Oil-in-Place--Initial quantity of oil in reservoir.

Paleontology--A science dealing with the life of past geological periods as known from fossil remains.

Particulate--A particle of solid or liquid matter--soot, dust, aerosols, fumes and mist.

Perennial Stream--A stream receiving water from both surface and underground sources that flows throughout the entire year.

Permeability--The rate of diffusion of a fluid through a porous body under standard conditions of area, thickness and pressure.

pH--A numeric value that gives the relative acidity or alkalinity of a substance on a 0 to 14 scale with the neutral point at 7. Values lower than 7 show the presence of acids, and values greater than 7 show the presence of alkalis.

Plan of Development--A mandatory plan, developed by an applicant, of a mining operation or construction project, that specifies the techniques and measures to be used during construction and operation of all project facilities on public land. The plan is submitted for approval to the appropriate federal agency before any construction begins.

ppm--Part per million.

Prehistoric--Archaeological sites resulting from the activities of aboriginal peoples native to this region, and because dating is often difficult, extending up to the reservation era (ca. A.D. 1868).

Prevention of Significant Deterioration (PSD)--A regulatory program based not on the absolute levels of pollution allowable in the atmosphere but on the amount by which present air quality will be allowed to deteriorate in a given area. Under this program, geographic areas are divided into three classes, each allowing different increases in increments of total suspended particulates and sulfur dioxide concentrations.

Class I--minimal additional deterioration in air quality (certain national wilderness areas).

Class II--moderate additional deterioration in air quality (most lands).

Class III--greater deterioration for planned maximum growth (industrial areas).

Primary Production--Oil and gas produced by natural reservoir energy or forces.

Prime Farmland--Land that is best suited for producing food, feed, forage, fiber and oilseed crops. The

inventory of prime agricultural land is maintained by the U.S. Department of Agricultural, Soil Conservation Service.

Proposed Action--Construction activities, alignments and other activities proposed by the applicant. In this case, the proposed actions represent Amoco's five projects in locations and in a timing sequence as proposed by the company. Mitigation measures, proposed by Amoco to reduce specific project-related impacts, form an integral part of the proposed actions.

psi--Pounds per square inch.

Reclamation--The process of converting disturbed land to its former use or other productive uses.

Recreation Opportunity Spectrum (ROS)--A planning and management framework for stratifying and defining classes of outdoor recreation environments, activities and experience opportunities. The settings, activities and opportunities for obtaining experiences have been arranged along a continuum or spectrum divided into six classes: primitive; semiprimitive nonmotorized; semiprimitive motorized; roaded natural; rural; and urban.

RJT--Ring Joint Type. A type of joint with grooved flanges and a loose ring.

ROD--Record of decision.

RTU--Radio transmitting unit.

SCDA--Supervisory control and data acquisition.

Scraper Traps--A device used to clean the inside surfaces of pipelines.

Secondary Recovery--Enhanced recovery following primary production but may be conducted concurrently with primary recovery. Any additional production resulting from the introduction of artificial energy into the reservoir.

Sensitive Plant Species--Plants whose populations are consistently small and widely dispersed or whose ranges are restricted to a few localities, such that any appreciable reduction in numbers, habitat availability, or habitat condition might lead toward extinction. Sensitive plants also include species rare in one locality but abundant elsewhere. See Endangered Species and Threatened Species.

SHPO--State Historic Preservation Office.

Soil Productivity--The capacity of a soil to produce a plant or sequence of plants under a system of management.

Soluble--Degree to which two materials can be dissolved or passed into a solution. The ability to which two fluids, solids or gases can be mixed to form a homogeneous mixture.

Solution Gas Drive--Just as CO_2 goes into solution with an increase in reservoir pressure, gas will come out of solution and continue to drive oil into the wellbore. Reinjected gas will maintain the pressure in the gas cap which will keep most of the dissolved gas in the oil allowing higher production rates to be maintained. This mechanism of blowdown recovery is similar to solution gas drive during the primary production depletion of an oil field.

Sweep--Ability to quickly saturate throughout the entire reservoir.

TCF--Trillion Cubic Feet.

TCPU--U.S. Bureau of Economic Analysis abbreviation for Transporta-

tion, Communication and Public Utilities.

TEG--Triethylene glycol.

Threatened Species--Any plant or animal species likely to become endangered within the foreseeable future throughout all or part of its range.

Total Dissolved Solids (TDS)--An aggregate of carbonates, bicarbonates, chlorides, sulfates, phosphates and nitrates of calcium, magnesium, manganese, sodium, potassium and other cations that form salts. High TDS solutions can change the chemical nature of water, exert varying degrees of osmotic pressures, and often become lethal to life in an aquatic environment.

Total Suspended Solids (TSS)--Soil and rock particles carried in a suspension by stream flow.

Trona--A hydrated mixture of sodium carbonate and sodium bicarbonate. Trona is a source of soda ash.

UIC--Underground injection control.

Viscosity--The internal friction of a fluid, caused by molecular attraction, which makes it resist a tendency to flow. A viscous fluid is one having a cohesive and sticky consistency.

WAG--Water alternating gas.

WAAQS--Wyoming ambient air quality standards.

Wild and Scenic River--A river or section of river designated as such by congressional action under the 1968 Wild and Scenic Rivers Act, as supplemented and amended, or those sections of rivers designated as wild, scenic or recreational by an act of the legislature of the state or states through which they flow.

Vegetation Type--A plant community with distinguishable characteristics described by the dominant vegetation present.

Visual Resource Management Class (VRM Class)--The degree of visual change acceptable within the existing characteristic landscape. An area's classification is based upon the physical and sociological characteristics of any given homogeneous area and serves as a management objective.

Waterflooding--One method of secondary recovery in which water is injected into an oil reservoir to force additional oil out of the reservoir rock and into the well bores of producing wells.

Wilderness Study Area (WSA)--A roadless area or island that has been inventoried and found to have wilderness characteristics as described in Section 603 of the Federal Land Policy and Management Act and Section 2(c) of the Wilderness Act of 1964 (78 Stat. 891).

Workforce--The total number of workers on a specific project or group of projects. The workforce is also referred to as direct employment and primary employment.

Xeric--Adapted to a dry environment.

APPENDIX 1
PROVISIONS AND MEASURES DESIGNED TO REDUCE ENVIRONMENTAL IMPACTS

WYOMING BLM STANDARD MITIGATION MEASURES FOR SURFACE-DISTURBING ACTIVITIES

The objectives of these mitigation measures are to reserve, for the Bureau, the right to modify the operations of all surface-disturbing activities as part of our statutory requirements for environmental protection and to inform a potential lessee, permittee, or operator of the environmental conditions present in a given area. The measures are the Bureau's statewide standards for addressing environmental concerns and serve to alert the applicant or permittee of general requirements to be met prior to or during use of the public lands.

These measures have been written to provide a basic standardized format with wording that will allow for the addition of specialized mitigation criteria following the submission of a detailed plan of development, or other project proposal and preparation of an environmental analysis.

SURFACE DISTURBANCE MITIGATION

Surface disturbance will be prohibited in any of the following areas or conditions. Modifications to this limitation may be approved in writing by the Authorized Officer.

1. Slopes in excess of 25 percent.
2. Within important scenic areas (Class I and II Visual Resource Management areas).
3. Within 500 feet of surface water and/or riparian areas.
4. Within a quarter mile or visual horizon (whichever is closer) from historic trails.
5. Construction with frozen material or during periods when the soil material is saturated, frozen, or when watershed damage is likely to occur.

Guidance

These surface disturbance mitigation measures will be included in all BLM authorizations. The intent is to inform interested parties (potential lessees, permittees, operators) that when one or more of the five (1 through 5) environmental conditions exist, surface-disturbing activities will be prohibited unless or until the permittee or his designated representative and the surface management agency (SMA) arrive at an acceptable plan for mitigation of anticipated impacts. This negotiation will occur prior to development and become a condition for approval when authorizing the action.

Specific criteria (e.g., 500 feet from water) have been established based upon the best information available. However, geographical areas and time periods of concern must be delineated at the field level (i.e., "surface water and/or riparian areas" may include both intermittent and ephemeral water sources or may be limited to perennial surface water). These decisions, where possible, should be documented in the land use planning documents.

Modification of these mitigation measures must allow for other measures to be applied on a site-specific basis, if necessary, to mitigate the

impacts of concern. Waiver of this stipulation must be based upon demonstration, through environmental analysis, plans of development, plans of operation, Application for Permit to Drill processing, etc., that adverse effects to the area or condition of concern will be mitigated or avoided.

WILDLIFE MITIGATION MEASURES

1. To protect important big game ungulate winter habitat, activities or surface use will not be allowed during the period from November 15 to April 30 within certain areas encompassed by the authorization. The same criteria applies to elk calving areas from the period of May 1 to June 30. This limitation does not apply to extended long-term operation and maintenance of the project. Modifications to this limitation in any year may be approved in writing by the Authorized Officer.

2. To protect important raptor and/or sage and sharp-tailed grouse nesting habitat, activities or surface use will not be allowed during the period from February 1 to July 31 within certain areas encompassed by the authorization. This limitation does not apply to extended long-term operation and maintenance of the project. Modification to this limitation in any year may be approved in writing by the Authorized Officer.

3. No activities or surface use will be allowed on that portion of the authorization area identified within (legal description) for the purpose of protecting (e.g., sage/sharp-tailed grouse strutting, and/or other species/activity) habitat. Modifications to this limitation in any year may be approved in writing by the Authorized Officer.

Guidance

These wildlife mitigation measures are intended to provide two basic types of protection season restriction (1 and 2) and prohibition of activities or surface use (3). Legal descriptions will ultimately be required and should be measurable and legally definable. There are no minimum subdivision requirements at this time. The area delineated can and should be refined as necessary based upon current biological data prior to the time of plan processing and use authorization. The legal description must eventually become a condition for approval of the permit, plan of development and/or other use authorization.

The seasonal restriction section of the mitigation identifies three groups of species and delineates two similar time frame restrictions. These two restrictions are big game ungulate and raptors/grouse. The big game ungulates including elk, moose, deer, antelope, and big horn sheep all require protection of crucial winter range between November 15 and April 30. Raptors including eagles, accipiters, falcons, buteos, osprey, ferruginous hawks, burrowing owls, and sage and sharp-tailed grouse all require nesting protection during periods between February 1 and July 31.

The prohibition of activity or surface use section of mitigation 2c is intended for protection of unique wildlife habitat areas or values that are limiting factors to life-cycle activities (e.g., sage grouse strutting grounds, known threatened and endangered species' habitat, etc.) which cannot be protected using seasonal restrictions.

Modification of these mitigation measures must allow for other measures to be applied on a site-specific basis, if necessary, to mitigate the impacts of concern. Waiver of this measure

must be based upon demonstration, through environmental analysis, plans of development, plans of operation, Application for Permit to Drill processing, etc., that adverse effects to the area or condition of concern will be mitigated or avoided.

SPECIAL RESOURCE MITIGATION MEASURE

To protect (resource value), the District Manager reserves the right to prohibit activities or surface use (i.e., within a specific distance of the resource value or between date-to-date) in (legal subdivision). This limitation does not apply to extended long-term operation and maintenance of the project. Modifications to this limitation may be approved in writing by the Authorized Officer.

Example resource categories (select category and identify specific resource value):

1. Recreation areas.
2. Special historic features.
3. Special management areas.
4. Sections of major rivers.
5. Prior existing rights-of-way.
6. Occupied dwellings.

Guidance

This special resource mitigation measure is intended for use only in site-specific situations where one of the first two general mitigation measures will not adequately address the concern. The resource value, location and specific restriction must be clearly identified. A detailed plan addressing specific mitigation and special restrictions on development will be required prior to development and will become a condition for approval in the permit, plan of development, or other use authorization.

Modifications of this measure must allow for other mitigation to be applied on a site-specific basis, if necessary, to mitigate the impacts of concern. Waiver of this measure must be based upon demonstration, through environmental analysis, plans of development, plans of operation, Application for Permit to Drill processing, etc., that adverse effects to the area or condition of concern will be mitigated or avoided.

NO SURFACE OCCUPANCY

No surface occupancy will be allowed on the following described lands (legal subdivision/area) because of (resource value).

Example resource categories (select category and identify specific resource values):

1. Recreation areas (campgrounds, historic trails, national monuments.
2. Major reservoirs/dams.
3. Special management areas (ACEC, wild and scenic rivers).

Guidance

The no surface occupancy mitigation measure (NSO) is intended for use only when other mitigation is determined insufficient to adequately protect the public interest and/or as an alternative to "no development" or "no leasing." The legal subdivision and resource value of concern must be identified and tied to a land use planning document. There will be no exceptions to this mitigation measure granted without amendment of the appropriate land use plan.

Exception(s) to the NSO measure will be subject to the same test used to

initially justify its imposition. If the NSO measure is justified but, upon evaluation of site-specific plans of development, it is found that less restrictive mitigation would adequately protect the public interest, then an exception to the NSO mitigation measure could be granted by the State Director through a land use plan amendment. The record must show that because conditions and uses have changed, less restrictive mitigation measures will protect the public interest.

The Wyoming State Office advises that when considering the "no development" or "no leasing" option, a rigorous test must be met and fully documented in the record. This test must be based on stringent standards described in the land use planning document. Since rejection of all development rights is more severe than the most restrictive mitigation measure, the record must show that consideration was given to development subject to reasonable mitigation, including No Surface Occupancy. The record must also show that other mitigation was determined to be insufficient to adequately protect the public interest. A "no development" or "no leasing" decision should not be made solely because it appears that conventional methods of development would be infeasible, especially where an NSO authorization may be acceptable to a potential permittee. In such cases, the opportunity to accept or refuse an NSO authorization should be left to the potential permittee.

STANDARD PRACTICES APPLIED TO SURFACE-DISTURBING ACTIVITIES

The following are general standard operating procedures applied to surface-disturbing activities. These measures are applied, when necessary, to reduce environmental impacts. Some projects may require construction use plans and/or erosion control revegetation and restoration plans (ERRP).

ROADS

Recognized roads will be used when the alignment is acceptable for the proposed use. Generally, roads will be required to follow natural contours; be constructed in accordance with standards as described in BLM Road Standards and BLM Manual Section 9113; and be reclaimed to BLM standards.

In order to control or reduce sediment from roads, guidance involving proper road placement and buffer strips to stream channels, graveling, proper drainage, seasonal closure, and in some cases, redesign or closure of old roads. Construction may be prohibited during periods when soil material is saturated, frozen, or when watershed damage is likely to occur.

On newly constructed roads and permanent roads, the placement of topsoil, seeding and stabilization will be required on all cut and fill slopes (unless conditions prohibit this), e.g., rock. No unnecessary side-casting of material (e.g., maintenance) on steep slopes will be allowed. Snow removal plans may be required while a road is used for access so that snow removal does not adversely affect reclamation efforts or resources adjacent to the road.

Reclamation of abandoned roads will include requirements for reshaping, recontouring, resurfacing with topsoil, installation of water bars, and drill seeding on the contour. The removal of structures such as bridges, culverts, cattleguards and signs will be required. Stripped vegetation will be spread over the disturbance for nutrient recycling, where practical. Fertilization or fencing of these disturbances will not normally be required. Additional erosion control measures (e.g., fiber matting) and road barriers to discourage travel may be required.

Road closures may be needed during spring runoff periods, in elk wintering areas, or other critical areas.

WELL PADS AND FACILITIES

Abandoned sites must be satisfactorily rehabilitated (in accordance with a plan approved by BLM) by the lessee.

On well pads and larger locations, special attention will be given to parts of the surface use plan covering reclamation. This plan will include objectives for successful reclamation covering: soil stabilization, plant community composition and desired vegetation density and diversity.

No surface disturbance is allowed on slopes in excess of 25 percent unless erosion controls can be ensured and adequate revegetation is expected. Detailed engineering proposals and revegetation and restoration plans will be required in these areas.

On producing locations, operators will be required to reduce slopes to original contours (not to exceed 3:1 slopes). Terraces or elongated water breaks (erosion control measures) will be required after slope reduction. Facilities will be required to approach zero runoff from the location until the area is stabilized (to avoid contamination and water quality degradation downstream). All unused portions of facilities or producing well locations will be resurfaced with topsoil and seeded with soil stabilizing species. Mulching, erosion control measures and fertilization may be required to achieve acceptable stabilization.

Abandoned locations will be required to be recontoured to conform to the surrounding terrain. Construction of erosion and runoff control measures and placement of topsoil will be required after recontouring.

The collection and analysis of soil samples from disturbed areas may be required to determine reclamation potential, appropriate seed mixtures, and nutrient deficiencies. This will be the responsibility of the grantee or lessee. Testing (as determined by BLM) may include: pH, mechanical analysis, limiting salt content, nitrogen, phosphorus and potassium.

Fertilization may be required if there is evidence of a nutrient deficiency. If needed to produce adequate germination and growth, the topsoil and selected seed species would be inoculated with soil microorganisms. The site will be drill seeded or broadcast (if slopes exceed 30 percent or contain 35 percent surface rock content). Mulching and fencing (unless deemed unnecessary due to low grazing pressure) will be required. Fences will be required to remain until reclamation is successful.

Snow fences, placed to increase snowfall depth over a reclaimed area, and reshaping to create shallow depressions (to catch surface runoff) may be required in areas receiving 10 inches or less of annual precipitation.

No sour gas lines will be located closer than one mile to a populated area or sensitive receptor. The applicants must use the best available engineering design (i.e., alignment, block valve type and spacing, pipe grade, etc.), best construction techniques (i.e., pipe depth, hydrostatic testing, etc.) and monitoring plans (i.e., surveillance, warning signs, etc.) as approved by the Authorized Officer to minimize both the probability of rupture and radius of exposure in the event of an accidental pipeline release of sour gas. A variance from the one-mile distance may be granted by the Authorized Officer based on detailed site-specific analysis that would consider meteorology, topography and special pipeline design and/or construction measures. This analysis would ensure that populated areas and sensitive receptors would not be exposed to an increased level of risk.

PIPELINES AND COMMUNICATIONS

Existing crowned and ditched roads will be used where possible to minimized surface disturbances.
Where possible, clearing of pipeline and communication line rights-of-way will be accomplished with the least degree of disturbance to topsoil. Where topsoil removal is necessary, it will be stockpiled (windrowed) and respread over the disturbance after construction and backfilling are completed. Vegetation removed from the right-of-way will also be required to be respread to provide protection, nutrient recycling and a natural seed source.

To promote soil stability, the compaction of backfill will be required (not to extend above the original ground level after the fill has settled). Water bars, mulching and terracing will be required, as needed, to minimize erosion. In-stream protection structures (e.g., drop structures) may be required in drainages crossed by a pipeline to prevent erosion.

The fencing of linear disturbances near livestock watering areas (distance determined on site-specific basis) may be required.

If linear facilities follow the same right-of-way for all or part of the route, they will generally be required to be constructed so that only one reclamation effort is required. Generally, they will be required to be constructed either concurrently or during the same field season.

AIR QUALITY PROTECTION MEASURES

As major sources of air pollutant emissions are planned, special air quality protection-related stipulations are added to BLM grants of rights-of-way necessary for construction. In addition, the BLM coordinates with the Wyoming Department of Environmental Quality/Air Quality Division (WDEQ/AQD) during the issuance of permits to construct emission sources. This coordination often results in the technical review of applications for permits and commenting on or requesting the addition of stipulations to these permits.
The release of hazardous air contaminants, particularly the emissions from sour natural gas sweetening plants (a process used to remove H_2S from natural gas resulting in the emission of sulfur dioxide), has caused much public concern. BLM requires industry to prepare detailed analyses of risks involved with the development of sour gas pipelines and treatment facilities. These analyses are designed to project impacts both to the public and to resource values. Plant siting will be scrutinized to ensure that only areas with the least potential for the transport of pollutants to the wilderness are considered. To aid in achieving these goals, BLM will consult with the State of Wyoming, the U.S. Forest Service, industry and the public to ensure that the most technically sound, environmentally balanced and economically feasible decisions are made.

RECLAMATION

The objectives for reclamation efforts emphasize: 1) stabilization through establishment of ground cover; 2) establishment of vegetation consistent with land use planning; and 3) reduction of visual contrast.

Reclamation will be required on all disturbed areas. On roads left intact for access purposes, the stabilization of all disturbed areas except the running surface will be required.

Only areas needed for construction will be allowed to be disturbed. Reclamation (by the lessee or grant holder) will be initiated as soon as possible after a disturbance occurs. Continued efforts will be required until satisfactory vegetation cover is established and the site is stabilized.

Topsoil

Before a surface-disturbing activity is authorized, the BLM will determine total topsoil depth. The amount of topsoil to be removed, along with topsoil placement areas, will be specified in the authorization. The uniform distribution of topsoil over the area to be reclaimed will be required, unless conditions warrant a varying depth. On large surface-disturbing projects (e.g., gas processing plants) topsoil will be stockpiled, mulched and seeded to reduce erosion. Where feasible, topsoil stockpiles will be required to be designed to maximize surface area to reduce impacts to soil microorganisms. Areas used for spoil storage will be required to be striped of topsoil before spoil placement. The replacement of topsoil after spoil removal will be required.

Temporary disturbances which do not require major excavation (e.g., pipelines and communication lines) may be stripped of vegetation to ground level using mechanical treatment, leaving topsoil intact and root mass relatively undisturbed.

Seeding

Only plant species adaptable to local soil and climatic conditions will be utilized in revegetation efforts. On all areas to be reclaimed, seed mixtures will be required to be site-specific and will be required to include species promoting soil stability. Livestock palatability and wildlife habitat needs will be given consideration in seed mix formulation. Interseeding, secondary seeding, or staggered seeding may be required to accomplish revegetation objectives.

A friable, but firm seed bed will be required prior to seeding. Drill seeding will be required unless conditions indicate that broadcast seeding is necessary (e.g., greater than 30 percent slope or greater than 35 percent rock content). During rehabilitation of areas in important wildlife habitat, provision will be made for the establishment of native browse and for species, if determined to be beneficial for the habitat affected.
Follow-up seeding or corrective erosion control measures may be required on areas of surface disturbance which experience reclamation failure.

Treatments

Trees, shrubs and ground cover (not to be cleared from rights-of-way) will require protection from construction damage. Backfill will be required to be replaced in a similar sequence and density to preconstruction condition. The restoration of normal surface drainage will be required.

Any mulch used will be free from mold, fungi, or noxious weed seeds. Mulch may include native hay, small grain straw, wood fiber, live mulch, cotton, jute, synthetic netting and rock. Straw mulch should contain fibers long enough to facilitate crimping and provide the greatest cover.

The grantee or lessee will be responsible for the control of all noxious weed infestations on surface disturbances. Control measures will adhere to those allowed in the Rock Springs District Noxious Weed Control EA (USDI 1982a) or the Regional Northwest Area Noxious Weed Control Program EIS (USDI 1985c).

U.S. DEPARTMENT OF THE ARMY, CORPS OF ENGINEERS PRESCRIBED MANAGEMENT PRACTICES

The Army Corps of Engineers has prescribed management practices that should be followed, to the maximum extent practical, for discharges covered by the Nationwide 404 Permit (items 1 through 8). Additionally, certain conditions (33 CFR 323.4-3 (b)) must be met under the Nationwide Permit authority (items 9 through 16). For further detail, please see the Army Corps of Engineers Permit Program, A Guide for Applicants, November 1, 1977.

1. Discharges of dredged or fill material into United States waters should be avoided or minimized through the use of other practical alternatives.

2. Discharges in spawning areas during spawning seasons should be avoided.

3. Discharges should not restrict or block the movement of aquatic species indigenous to the waters, impede the passage of normal or expected high flows, or cause the relocation of the waters (unless the main purpose of the fill is to impound water).

4. If any discharge creates an impoundment, adverse impacts on the aquatic system caused by the accelerated passage of water or the restriction of its flow should be minimized.

5. Discharges in wetlands should be avoided.

6. Heavy equipment used in wetlands should be placed on mats.

7. Discharges into breeding and nesting areas for migratory waterfowl should be avoided.

8. All temporary fills should be entirely removed.

9. Preconstruction bottom contours cannot change. (Excess material must be removed to an upland disposal area.)

10. The discharge cannot occur in the proximity of a public water supply intake structure.

11. The discharge cannot destroy a threatened or endangered species as identified under the Endangered Species Act or endanger the critical habitat of such species.

12. The discharge cannot disrupt the movement of aquatic species indigenous to a water body.

13. The discharge must consist of suitable material that is free of toxic pollutants in other than trace amounts.

14. The fill created by a discharge must be properly maintained to prevent erosion and other nonpoint pollution sources.

15. The discharge must not occur in a component of the national wild and scenic river system or in a component of a state wild and scenic river system.

16. No access roads, fills, dikes or other structures can be built below the ordinary high water of the streams specified under the Nationwide Permit. These structures would require separate Section 404 permits.

U.S. ENVIRONMENTAL PROTECTION AGENCY PRESCRIBED MITIGATION MEASURES

Since construction of the pipeline will involve river crossings, a Nationwide Section 404 Permit will be required. Generally river crossings are covered under the permit, although specific permits (Individual 404 and Section 10 permits) will be needed for important crossings. An individual permit will be required if filling of any wetlands is involved. The U.S. Environmental Protection Agency reviews applications for 404 permits administered by the Army Corps of Engineers and provides recommendations for action on the permit, including mitigation measures. For this project, the U.S. Environmental Protection Agency will likely recommend the following measures for major river crossings:

a. Dredged materials should be stored away from the flowing waters;

b. Disturbed wetland or riverine areas should be revegetated with native trees, shrubs and grasses where applicable;

c. The permit should consider appropriate times for river disturbance that do not interrupt fish spawning cycles. This consideration may involve identifying the <u>gaps</u> or <u>windows</u> for construction between different spawning seasons;

More mitigation measures will be considered for the following areas after more details are received:

d. Provisions for backfillings;

e. Lengths of riprap involved; perhaps some limitations to minimize use of riprap.

APPENDIX 2
ENDANGERED SPECIES ACT COMPLIANCE

The Endangered Species Act of 1973 requires, under Section 7, that any federal agency carrying out any action that might affect an endangered species must consult with the U.S. Department of the Interior, Fish and Wildlife Service concerning the effects of the projects on threatened or endangered species.

The correspondence contained in this appendix is the Fish and Wildlife Service response to BLM's request for information on listed species in the project area.

UNITED STATES
DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE

Fish and Wildlife Enhancement
Wyoming State Office
2120 Capitol Avenue, Room 7010
Cheyenne, Wyoming 82001

IN REPLY REFER TO:

November 16, 1987

1 2 3 NOV 1 1987 Coler GN

W.02 Amoco CO_2 Projects

MEMORANDUM

To: District Manager, Casper District, Bureau of Land Management, Casper, WY

From: State Supervisor, Wyoming State Office, Fish and Wildlife Enhancement, Fish and Wildlife Service, Cheyenne, WY

Subject: Amoco CO_2 Projects - Species List

This responds to your October 29, 1987, letter regarding the proposed Amoco CO_2 Projects in Lincoln, Fremont, Natrona, Hot Springs, Washakie, Big Horn, and Park Counties, Wyoming.

In accordance with Section 7(c) of the Endangered Species Act as amended (ESA), and the Interagency Cooperation Regulation (50 CFR 402.12(c)), we agree that your biological assessment should address the species identified in your letter. The expected occurrence of these endangered species in the project areas follow:

Listed Species	Expected Occurrence
Bald eagle (Haliaeetus leucocephalus)	Winter resident, migrant
Peregrine falcon (Falco peregrinus)	Migrant
Whooping crane (Grus americana)	Spring-fall resident, migrant (Lincoln, Sweetwater, and Fremont Counties)
Black-footed ferret (Mustela nigripes)	Potential resident in prairie dog (Cynomys sp.) towns

Proposed Species

None

Section 7(c) of the Act requires that Federal agencies, proposing major Federal construction actions, conduct a biological assessment to determine the effects of the proposed actions on listed and proposed species. If the biological assessment is not initiated within 90 days, the list of threatened and endangered species should be verified with the Fish and Wildlife Service (Service) prior to initiation of the assessment. The biological assessment should be completed within 180 days of initiation, but can be extended by mutual agreement between your agency and the Service. The biological assessment may be undertaken as part of your agency's compliance of Section 102 of National Environmental Policy Act, and incorporated into the draft or final document. A Federal agency may designate a non-Federal representative to conduct informal consultation or prepare a biological assessment by giving written notice to the Service of such designation. If a biological assessment is prepared by the designated non-Federal representative, the Federal agency shall furnish guidance and supervision and shall independently review and evaluate the scope and contents of the biological assessment. The ultimate responsibility for compliance with Section 7 remains with the Federal agency. We recommend that the biological assessment include:

1) a description of the project;

2) the current status, habitat use, and behavior of listed species in the project area;

3) discussion of the methods used to determine the information in item 2;

4) direct and indirect impacts of the project to listed species;

5) cumulative impacts from federal, state, or private projects in the area;

6) coordination measures that will reduce/eliminate adverse impacts to listed species;

7) the expected status of listed species in the future (short- and long-term) during and after project completion;

8) determination of "no effect/may affect" to listed species;

9) citation of literature and personal contacts used in assessment.

If it is determined that the project "may affect" any of the above listed species, formal consultation should be initiated with us. If it is concluded that "no effect" is likely, we should be asked to review the assessment and concur with the determination of no effect.

Section 7(d) of the Act requires that the Federal agency and permit or license applicant shall not make any irreversible or irretrievable commitment of resources which would preclude the formulation of reasonable and prudent alternatives until consultation on listed species is completed.

As requested in your letter, candidate species which may occur within the project areas follow:

Candidate Species	Expected Occurrence
White-faced ibis (Plegadis chihi)	Summer resident
Swainson's hawk (Buteo swainsoni)	Summer resident
Ferruginous hawk (Buteo regalis)	Year-round resident
Mountain plover (Charadrius montanus)	Summer resident of semi-arid grasslands, shortgrass prairies, plains, and plateaus
Long-billed curlew (Numenius americanus)	Spring/summer resident
Allen's 13-lined ground squirrel (Spermophilus tridecemlineatus alleni)	May occur outside mountainous areas
Wyoming cave snail (Physa spelunca)	Resident of Lower Cane Cave, near Lovell, Wyoming
Astragalus jejunus (no common name)	May occur on plains and hills in southwest Wyoming. No specific information
Spiderflower (Cleome multicaulis)	Alkali wet meadows in desert regions. No specific information

Please contact us by mail at the above letterhead address or by telephone at (307) 772-2372 (FTS 328-5225), or Carol Taylor at FTS 585-5225 if we can be of further assistance.

R. T. Starkey

cc: Montana/Wyoming Field Office, FWS (FWE-61125), Helena, MT
Regional Director, FWS (FWE-60153), Denver, CO
Director, WGFD, Cheyenne, WY
WGFD, Lander, WY (Ritter)

CMT/clh
FWE-61411:RGS/cmr (EMail:AMOCOCO2.REM:11/16/87)

1793 Elk Basin

UNITED STATES
DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE
Fish and Wildlife Enhancement
2120 Capitol Avenue, Room 7010
Cheyenne, Wyoming 82001

CASPER BLM
MAR 21 '88
1 DM MN
2 ADM FL
PA SL
AO BRA
OPR NRA
3 LRR PRA
CT Lead Resp

IN REPLY REFER TO:
W.02 Amoco CO2 Projects

March 18, 1988

MEMORANDUM

Colen
GN

To: District Manager, Casper District, BLM, Casper, WY
Attention: Larry Apple

From: State Supervisor, Wyoming State Office, FWS/FWE, Cheyenne, WY

Subject: Amoco CO2 Projects - Candidate Species

We have reviewed your February 26, 1988 letter, and Planning Information Corporation's February 15, 1988 letter requesting the addition of five candidate species to our November 16, 1987 species list. Although candidate species have no legal protection under the Endangered Species Act of 1973 as amended; the Interagency Cooperation Regulations (50 CFR 402) provide for inclusion of candidate species in species lists; to alert Federal agencies to their occurrence and potential consideration for future listing proposals. Candidate species are assigned to different "status" categories, which are defined in Table 1 (attached). Your letter requested that we add the following candidate species to our species list for the Amoco CO2 Projects:

1. Narrow foot hygrotis diving beetle (Hygrotus diversipes) is a Category 2 candidate species known from Dugout, Cloud, and Dead Horse Creeks in northern Natrona County.

2. Porter's sagebrush (Artemisia porteri) is a Category 3C candidate species. We do not include Category 3C species in species lists. However, if the Bureau of Land Management (BLM) or Amoco believes this species should be considered; then you should include it in the assessment.

3. Cryptantha subcapitata is a Category 2 plant. The only information we have is from the Lander Grazing Supplement Final Environmental Statement, which says; "...a perennial herb occurring in the Wind River Canyon. The plant is found at high altitudes in limestone derived soils." We would appreciate any additional information you can provide on this plant.

4. Cymopterus sp. nov./ined is another Category 2 plant that we have no information for. Several Cymopterus species have been named since the last plant Notice of Review (September 27, 1985); however, until a new notice is completed, we do not know which species name was assigned to this plant. Since evertii may be the species name assigned to Cymopterus sp. nov./ined, we would appreciate any information you can provide on this species.

5. Meadow pussytoes (Antennaria arcuata) is a Category 2 candidate plant, that we recommended Category 3C status for after review of the Rocky Mountain Heritage Task Force's 1986 status report.

When Federal agencies request information on candidate species, our species lists include those Category 1 and 2 candidates for which we have information. You should be aware, however, that Federal agencies and project sponsors may include additional species in their biological assessments, if they so choose; even if those species were not included in our list. One of the major purposes of the Notices of Review is to request that agencies and other appropriate parties submit pertinent information on candidate species to the Service. Therefore, we encourage you to include the above species in your biological assessment, and request that you provide us with any additional data you obtain.

We appreciate you efforts to evaluate potential impacts to candidate species, and thank you in advance for providing additional data on these species. Please contact us by mail at the above letterhead address, or by telephone at FTS 328-2372 or 307-772-2372; or Carol Taylor at FTS 585-5225 or 406-449-5225 if we can be of further assistance.

R.G. Starkey

cc: MT/WY Field Office, FWS, Helena, MT
ARD/FWE, FWS, Denver, CO
Director, WGFD, Cheyenne, WY
Nongame Coordinator, WGFD, Lander, WY

Table 1. STATUS CATEGORIES for CANDIDATE SPECIES

Category 1 comprises taxa for which the Fish and Wildlife Service (Service) currently has substantial information on hand to support the biological appropriateness of proposing to list as endangered or threatened. Proposals have not yet been issued because they have been precluded at present by other listing activity. Development and publication of proposed rules on these taxa are anticipated, however, and the Service encourages Federal agencies and other appropriate parties to give consideration to such taxa in environmental planning.

Category 2 comprises taxa for which information now in possession of the Service indicates that proposing to list as endangered or threatened is possibly appropriate, but for which conclusive data on biological vulnerability and threat are not currently available to support proposed rules. There are no specific plans to propose listing for these taxa, unless additional information becomes available. Further biological research and field study may be needed to ascertain the status of taxa in this category, and it is likely that many will be found to not warrant listing. The Service encourages investigation of the status and vulnerability of these taxa, and consideration of them in the course of environmental planning.

Category 3 comprises taxa that were once being considered for listing as endangered or threatened (Categories 1 and 2), but are not currently receiving such consideration. These taxa are included in one of the following three subcategories.

Subcategory 3A comprises taxa for which the Service has persuasive evidence of extinction. If rediscovered, however, such taxa might warrant high priority for addition to the List of Endangered and Threatened Wildlife and Plants.

Subcategory 3B comprises taxa that were once thought to be biological species or subspecies, but that, on the basis of recent systematic work, usually as represented in published revisions and monographs, are not now considered distinctive and do not meet the Endangered Species Act's legal definition of species. Future systematic investigation could lead to reevaluation of listing qualifications of such taxa.

Subcategory 3C comprises taxa that are now considered to be more abundant or widespread, and/or substantially less subject to identifiable threats, than previously thought. Should new information suggest that any such taxon is experiencing a numerical or distributional decline, or is under a substantial threat, it may be considered for transfer to category 1 or 2.

This information is compiled from Endangered and Threatened Wildlife and Plants: Notices of Review, as published in the Federal Register (FR 50(181):37958 and FR 50(188):39526).

United States Department of the Interior

BUREAU OF LAND MANAGEMENT
CASPER DISTRICT OFFICE
1701 EAST E STREET
CASPER, WYOMING 82601

TAKE PRIDE IN AMERICA

1793 Elk Basin

MAR 3 1 1988

Aaron Clark
Planning Information Corporation
1801 Broadway
Suite 920
Denver, CO 80202

Dear Mr. Clark:

The U.S. Fish and Wildlife Service has responded to our recent request to add five species to the candidate species list to be analyzed in the biological assessment. They have concurred with our request and have encouraged us to include the following species in the analysis, and to provide them with any additional data that may be obtained. Therefore, please include the following species in your analysis:

Hygrotis diversipes	(Narrow-footed hygrotis diving beetle)
Artemisia porteri	(Porter's sagebrush)
Cryptantha subcapitata	(Owl Creek miner's candle)
Cymopterus evertii	(Evert's water parsnip)
Antennaria arcuata	(Meadow pussytoes)

A copy of the March 18, 1988 letter from the Fish and Wildlife Service is enclosed. If you have any comments or questions please contact either Glen Nebeker or Larry Apple at (307) 261-5101. (Comm.)

Sincerely,

James W. Monroe

District Manager

Enclosure

APPENDIX 3
MEMORANDUM OF AGREEMENT ON CULTURAL RESOURCES

This appendix includes:

1. The Memorandum of Agreement for the Bairoil/Dakota Carbon Dioxide Project in Wyoming, Montana and North Dakota; and

2. Attachment C -- Roles of Participants and Summary of Procedures for Amoco Carbon Dioxide Projects.

MEMORANDUM OF AGREEMENT
Bairoil/Dakota Carbon Dioxide Project
in Wyoming, Montana, and North Dakota

WHEREAS, the Exxon Company USA (Exxon), Amoco Production Co. (Amoco), and Shell Pipeline Corporation (Shell) have applied to BLM for separate rights-of-way for several separate pipelines, a gas plant, and other facilities in Wyoming, Montana, and North Dakota and these right-of-way applications are being considered in a collective manner as the Bairoil/Dakota Carbon Dioxide Project; and

WHEREAS, the Bureau of Land Management (BLM), the Forest Service (FS), and the Army Corps of Engineers (COE) have determined that issuance of rights-of-way for the Bairoil/Dakota Carbon Dioxide Project, as described in BLM's project preliminary Draft Environmental Impact Statement, June 1985, will have an effect on properties included in, eligible for, and potentially eligible for the National Register of Historic Places (i.e., cultural properties) and have requested the comments of the Advisory Council on Historic Preservation (Council) pursuant to Section 106 of the National Historic Preservation Act (16 U.S.C. 470) and its implementing regulations (36 CFR Part 800); and

WHEREAS, the Wyoming BLM (through the Casper District Office) will act as lead agency for all Federal agencies involved in this project;

NOW, THEREFORE, BLM, FS, COE, the Wyoming, Montana, and North Dakota State Historic Preservation Officers (SHPOs), and the Council agree that the undertaking shall be implemented in accordance with the following stipulations in order to take into account the effect of the undertaking on cultural properties.

STIPULATIONS

BLM shall ensure that the following measures are carried out:

I. Procedures and Roles:

All work set forth in this Agreement will be carried out in accordance with this Agreement and with a Procedures and Roles Document(s) for each Applicant that is acceptable to the signatories to this Agreement. The Roles and Procedures Documents for Exxon are appended as Appendices A and B, respectively. All work on the project segments for which the Exxon is the Applicant will be carried out in accordance with Appendices A and B and this Agreement. When other Applicants decide to implement their project plans, the Appendices A and B may be used or different such documents may be developed, tailored to the Applicant and their project segments.

Tailored Procedures and Roles Documents will be developed by the BLM, in consultation with the Surface Management Agency (SMA) and SHPO(s). The Council and the SHPO(s) must concur in these tailored Procedures and Roles Documents prior to their implementation. If there is disagreement regarding the review of these Procedures and Roles Documents, BLM will seek to resolve the disagreement as per stipulation XII of this Agreement. Changes in Appendix A and/or B or tailored Procedures and/or Roles Documents will be developed and reviewed in this same manner.

II. Identification of Cultural Properties

A. All areas, regardless of surface ownership, which may potentially be affected by the undertaking will be inventoried to identify cultural properties listed in, eligible for, or potentially eligible for the National Register of Historic Places (National Register). All classes of cultural properties and properties of the historic and prehistoric periods will be so identified. Survey at BLM Class III standards will be conducted on all lands not previously inventoried to that level. The size of corridors and other areas to be surveyed at the Class III level will be determined by the BLM and SMA and SHPO(s) and will be specified in the Procedures and Roles documents. See Appendices A and B of this Agreement for the Exxon project segments. At a minimum, the area of maximum surface disturbance from the project will be surveyed.

B. Methods and levels of recording cultural properties will be determined by the BLM and SMA and SHPO(s) and will be specified in the Procedures and Roles Documents. See Appendices A and B of this Agreement for the Exxon project segments.

III. Testing and Evaluation of Cultural Properties

A. Strategies acceptable to the BLM and SMA and SHPO(s) will be developed and implemented for testing to determine if cultural properties are eligible for the National Register. These strategies will be specified in the Roles and Procedures Documents. See Appendices A and B of this Agreement for the Exxon project segments.

B. Preliminary evaluations to determine if subsurface cultural properties are potentially eligible for the National Register will be based on an examination of soil development for depositional situations amenable to the preservation of subsurface archeological deposits through shovel testing or formal testing, as specified in the Roles and Procedures Documents. If acceptable to the

SHPO(s), subsurface cultural properties appearing to be eligible for the National Register or to have a soil depositional environment amenable to the preservation of such subsurface archeological deposits will be considered as preliminarily eligible for the National Register. Adverse effects to properties determined to be preliminarily eligible for the National Register in accordance with this subsection or determined eligible under subsections III.C. or D., below, in consultation with the SHPO(s), will be avoided by project relocation where feasible and prudent. Further detail about implementation of this subsection will be specified in the Roles and Procedures Documents. See Appendices A and B for further detail about how this will be implemented on the Exxon project segments.

C. The identification, survey, and testing information, including the preliminary evaluations resulting from subsection III.B., above, will be reviewed by the BLM and SMA and SHPO(s) to determine if such properties are eligible for the National Register. If there is not sufficient information to make such a determination, strategies acceptable to the SHPO for acquiring needed information will be developed and implemented. See Appendices A and B for further detail of how this will be implemented on the Exxon project segments.

D. If the Federal agencies and SHPO(s) disagree regarding whether cultural properties are eligible for the National Register, BLM or other Federal SMA will seek a determination of eligibility from the Keeper of the National Register of Historic Places in accordance with 36 CFR Part 63. The Keeper's determination will be considered final for the purposes of this Agreement.

IV. Treatment Plans for Cultural Properties

A. The preferred treatment alternative is avoidance of effects on cultural properties by project relocation.

B. Standards for Treatment Plans:

Where it is not feasible and prudent to avoid adverse effects to National Register-eligible properties by project relocation, Treatment Plans will be developed to set forth means to avoid or mitigate the adverse effects of the project on National Register-eligible properties. Treatment Plans will be developed for the largest possible increment(s0 of the project, acceptable to BLM and SMA, the SHPO(s), and the Council.. The Treatment Plans will be in conformance with the principles in Part I and recommendations in Part II of the Council's "Treatment of

Archeological Properties: A Handbook" (Appendix C, attached) and the "Secretary of the Interior's standards and Guidelines for Archeology and Historic Preservation" (Federal Register, Vol. 48, No. 190, September 29, 1983, pp. 44716-44742) (Appendix D, attached). The Treatment Plans will take into account existing information to the maximum degree possible, especially in the formulation of subsections C.3., 5, and 6, below. These Treatment Plans will be implemented in accordance with this Agreement.

C. Contents of Treatment Plans will include, but not be limited to:

1. Specification of all cultural properties or portions of cultural properties to be affected by the project, including a description of the nature of such effects;

2. An explanation of the treatments proposed for cultural properties eligible for the National Register under criteria A, B, and/or C or portions of such properties, with an explanation or rationale provided for the choice of the proposed treatments;

3. An Archeological Research Design;

   For cultural properties eligible for the National Register under criterion D, an Archeological Research Design will be developed that specifies and explains the research questions to be answered by the data recovery efforts, the data needed to answer the questions posed including the sites and portions of sites to be investigated, and the methods to be used to address the research questions posed. Acceptable treatment options may include sampling of archeological sites which contain repetitive data and/or concentrating data recovery on sites or portions of sites that may yield the most significant information about history or prehistory. In addition, explanations or justification will be provided for the reasons for and appropriateness of the chosen research questions, data needs, specific sites and portions of sites proposed for data recovery, and methods proposed;

4. An explanation of the means and methods proposed for considering the concerns of Native American peoples, with a justification and rationale for the chosen means and methods;

5. An explanation of the areas of the project proposed for construction monitoring and open-trench inspection, with a justification or rationale for the areas so proposed;

6. Recommendations for the treatment of classes of cultural properties discovered by the open trench inspection and construction work monitoring. Recommendations will be made both for classes of cultural properties recommended as requiring further treatment and those requiring no further treatment, consistent with the Research Design above. Cultural property classes will be based on site type, cultural and temporal affiliation, etc. All recommendations will be justified and explained; and,

7. An explanation of all cultural properties that will be affected by the project for which no further treatment is proposed, with a justification or rationale for such proposed.

D. Distribution and Review of the Treatment Plans:

The Council and SHPO(s) will be afforded 5 working days to review the Treatment Plans. If the BLM, SMA, SHPO(s), or the Council disagree with the Treatment Plan(s) or the project's potential effects on a cultural property or portion of a cultural property that is eligible for the National Register, BLM will seek to resolve the disagreement in accordance with Stipulation XII of this Agreement. Cover letters transmitting Treatment Plan(s) will inform the Council and the SHPO(s) that the Plan is being forwarded in accordance with this Agreement, which provides for review within 5 working days.

V. Monitoring of Construction Work:

A. Monitoring of blading and/or trenching operations will be conducted in those areas determined appropriate by the BLM and SMA and SHPO. Areas to be monitored will be specified in the Treatment Plan(s). See also Appendices A and B of this Agreement for monitoring on the Exxon project segments. Such monitoring will be done in areas likely to yield significant buried cultural deposits (e.g., deep soils next to major drainages, etc.). Such monitoring will be done by a qualified archeologist.

B. Construction activities will be stopped in the area of potential effect surrounding a cultural property discovered during monitoring until the property's eligibility to the National Register has been determined and, if the property is found eligible, until a course of treatment has been determined and implemented.

C. Cultural properties discovered during monitoring will be recorded to a level sufficient to allow determinations of eligibility for the National Register to be made.

Emergency consultations or a meeting will be held within five working days of the cultural property's discovery. The eligibility of the cultural property will be determined in accordance with stipulation III.B and C., above. If the property is determined eligible, the BLM and SMA and SHPO will decide on a course of treatment consistent with the recommendations in the appropriate Treatment Plan.

D. The course of treatment for National Register-eligible cultural properties discovered during monitoring will be implemented in such a way to minimize or avoid delays to pipeline construction, to the extent feasible and prudent.

VI. Open Trench Inspection:

A. Inspection of open trenches for evidence of buried cultural properties will be conducted in some areas between completion of trenching and pipe-laying. Areas to be inspected will be determined by the appropriate BLM District and SMA and SHPO and will be specified in the Treatment Plan(s). See also Appendices A and B of this Agreement regarding open trench inspections on the Exxon project segements. Inspected areas will be those likely to yield significant buried cultural deposits.

B. Cultural properties discovered during the open trench inspection will be recorded and/or treated in accordance with stipulation V.C. and D., above.

VII. Reporting on the Investigations of Cultural Properties:

A. Reports generally will conform to the guidelines in the Council's "Treatment of Archeological Properties: A Handbook" and the "Secretary of the Interior's Standards and Guidelines for Archeology and Historic Preservation." Specific content and format will be approved by the appropriate BLM District and SMA and SHPO. BLM Districts will consolidate report review comments and send them to the SHPOs with requests for review. Scheduling of reports will take into account the amount of data recorded or analyses required, and other factors related to the reporting effort. The scheduling goal is to achieve timely, high quality reporting.

B. All aspects of survey, testing, and evaluation of cultural properties will be contained in a single formal report on a state-by-state basis or in several format reports for segments of the pipeline on a state-by-state basis. This report will be submitted to the BLM and SMA according to a schedule developed by the BLM, SMA, and SHPO.

C. Results of treatment will be reported on a state-by-state basis. These reports will be submitted to the BLM and

SMA according to a schedule developed by the appropriate BLM District, SMA, and SHPO after completion of all data recovery relevant to the Treatment Plans.

D. Results of monitoring and/or open-trench inspection will be reported on a state-by-state basis. This report will be submitted to the BLM and SMA according to a schedule developed by the appropriate BLM District, SMA, and SHPO after completion of the monitoring and open-trench inspection and data recovery resulting from monitoring and open-trench inspection in a given state.

E. A final project report will be completed that synthesizes all work undertaken pursuant to this Agreement and the results of such work. Format, content, and scheduling of this report will be worked out by by mutual agreement of the BLM, SMA, and SHPOs.

VIII. Evaluation of Cultural Properties After Completion of Cultural Resources Work:

Nominations to the National Register of Historic Places will be requested from the Keeper of National Register for those cultural properties that have been evaluated as eligible through consensus decision between the BLM and/or SMA and the SHPO in the conduct of this Agreement after the completion of all work called for in this Agreement.

IX. Policy on Landowner Denial of Access for Cultural Resource Work:

Significant cultural properties will be treated in such a way that adverse effects are either avoided or mitigated through effective treatment programs regardless of surface ownership. Should access be denied to any non-Federal lands to carry out the requirements of this Agreement, the Applicant will take all reasonable steps to obtain such access. Should further efforts fail to obtain access the appropriate BLM District and/or SMA will consult with the SHPO(s) and the Council per 36 CFR Sec. 800.4 to determine what further steps, if any, must be taken to satisfy the intent of this Agreement. Until such consultation is complete, neither the Applicant nor BLM will take or sanction any actions that would have an adverse effect on a cultural property which may be located on the property to which access has been denied.

X. Curation:

A. Collected cultural materials will be stabilized, labeled, and catalogued. Materials from FS lands in North Dakota will be curated by the FS under existing policies. Materials from Montana and other North Dakota lands will be placed in BLM's Montana Curation Center. Materials from Wyoming will be stored according to existing curation agreements.

B. The disposition of cultural materials from private lands will be determined by the landowner, after all analysis is completed. If the landowner wishes the materials to remain in government possession, they will be curated per stipulation X.A., above.

XI. Human Remains:

The BLM District or SMA will consult with appropriate Native American peoples regarding the treatment of Indian remains.

XII. Dispute Resolution:

Should there be disagreement regarding the implementation of this Agreement, the disagreeing parties will consult with the Council. Sufficient information describing the disagreement will be forwarded to the Council and the Council will make its recommendations within 15 working days from receipt of the documentation. The BLM and SMA and Applicant will adhere to the Council's recommendation or notify the Council's Executive Director as to why the recommendations cannot be followed and request that he ask the Chairman to schedule the issue for consideration at a Council meeting. Until the Chairman has responded and/or the Council has provided its comments, the BLM and SMA and Applicant will not take any action regarding the disputed issue that may affect cultural properties eligible for the National Register or potentially eligible for the National Register. Other aspects of this Agreement about which there is no disagreement may be implemented during the period of dispute resolution.

XIII. Failure to Carry Out the Terms of this Agreement:

Failure to carry out the terms of this Agreement requires that the BLM again request the Council's comments in accordance with 36 CFR Part 800. If the BLM or SMA or Applicant cannot carry out the terms of this Agreement, no actions shall be taken or sanctioned that would result in an adverse effect with respect to cultural properties which may be eligible for the National Register covered by the Agreement or that would foreclose the Council's consideration of modifications or alternatives to the project that could avoid or mitigate the adverse effect

until the commenting process has been completed.

XIV. Amendment to this Agreement:

If any of the signatories to this Agreement determines that the terms of this Agreement cannot be met or believes a change is necessary, that signatory shall immediately request the consulting parties to consider an amendment or addendum to this Agreement. Such an amendment or addendum shall be executed in the same manner as the original Agreement.

XV. Reporting on the Fulfillment of this Agreement:

Within 90 days after carrying out the terms of this Agreement, BLM will provide a written report to all signatories to the Agreement on actions taken to fulfill the terms of this Agreement.

Execution of this Memorandum of Agreement evidences that BLM, FS, and COE have afforded the Council a reasonable opportunity to comment on the Bairoil/Dakota Carbon Dioxide Project and its effects on cultural properties and that BLM, FS, and COE have taken into account the effects of the undertaking on cultural properties.

Montana State Historic Preservation Officer (date)

11/4/85

North Dakota State Historic Presrvation Officer (date)

10/30/85

Wyoming State Historic Preservation Officer (date)

10-23-85

Wyoming State Director Bureau of Land Management (date)

Jan 9, 1986

Executive Director Advisory Council on Historic Preservation (date)

27 Jan '86

Chairman Advisory Council on Historic Preservation (date)

FORM APPROVED
BY RMS

I concur:

D K Kiltan 12/9/85

Exxon Pipeline Co. (date)
Project Manager

Attachment C

ROLES OF PARTICIPANTS AND SUMMARY OF PROCEDURES

FOR AMOCO CARBON DIOXIDE PROJECTS

ROLES OF PARTICIPANTS AND SUMMARY OF PROCEDURES
FOR AMOCO CARBON DIOXIDE PROJECTS

CONTENTS

Attachment C

ROLES OF PARTICIPANTS AND SUMMARY OF PROCEDURES
FOR AMOCO CARBON DIOXIDE PROJECTS

I. ROLES OF PARTICIPANTS

A. Introduction

This document applies to all activities identified in the Amoco Carbon Dioxide Projects environmental impact statement, such as in-field development in the Elk Basin, Little Buffalo Basin, Beaver Creek, Salt Creek, and Raptor Unit fields and the trunk lines and any spur lines originating from each. In conformance with roles defined for other aspects of federal involvement in the Bairoil/Dakota Carbon Dioxide Project, the Bureau of Land Management (BLM) will coordinate actions required under the memorandum of agreement (MOA) for the Amoco Carbon Dioxide Projects. Tentatively, the project is expected to begin in 1989 and continue through the mid-1990s. Scheduling of activities is subject to change. This document will remain in effect throughout the life of the project unless it is modified according to sections III.A. and III.B.

B. Lead Office Responsibilities

The BLM office that is designated the lead office will be overall coordinator and will be responsible for coordinating cultural resource consultation and compliance activities in conformance with the MOA. These responsibilities include the following activities:

1. Monitoring the progress of all cultural resource work to ensure that its scheduling parallels other aspects of the undertaking. The lead office will communicate with the consulting parties and participants in MOA activities concerning potential problems in the progress or phasing of cultural resource work.

2. Serving as the federal contact with the Advisory Council on Historic Preservation (herein called "Council"), State Historic Preservation Officer (SHPO), and Amoco on matters related to the agreement.

3. Keeping a consolidated record of transactions among the participants in MOA activities. Consulting parties will forward

copies of correspondence, reports, telephone confirmations, and meeting notes to the lead office.

4. Coordination of the prework conference for the participants in MOA activities, the pretesting conference, and the post-testing conference.

5. Consolidation of reviews of draft reports by BLM districts and surface management agencies (SMAs) and forwarding of the information to the SHPO with a request for comments from that office.

C. SMA Responsibilities

The BLM districts and other SMAs will be responsible for carrying out the following activities:

1. Providing line management decisions and input for activities under the agreement that occur in their jurisdiction.

2. Monitoring progress and performance of the applicant's cultural resource use permittee (CRUP).

3. Reviewing and providing comments to the lead office on all reports.

4. Giving the lead office oral or written information for the consolidated record of activities under the agreement.

D. SHPO Responsibilities

The SHPO will perform review and compliance activities as defined in the MOA.

E. Other State Agencies

Any state agency that is not an SMA may become a concurring party to the agreement in conformance with existing agreements.

F. Applicant Responsibilities

The applicant will be an active participant in the agreement and consultation process and is a consulting party to the agreement. The following activities are the applicant's responsibility:

1. Covering all costs related to the hire of the cultural resourse use permittee(s) described below.

2. Hiring cultural resource use permittee(s) who have expertise in prehistory and history and who hold current authorization

for all federally administered lands affected by this project. The CRUP will perform the following activities:

a. Conducting surveys, testing, preliminary evaluation, mitigation, monitoring, and trench inspection on all lands affected by the project subject to stipulations II through X of the MOA

b. Preparing reports as specified herein

c. Attending all conferences designated in the agreement

3. Requiring that subcontractors and consultants engaged by the applicant comply with the terms of this agreement

II. SUMMARY OF MOA PROCEDURES

A. Introduction

These procedures are incorporated into the agreement through stipulation 1 of the MOA. They are intended to detail more specifically the nature and timing of various actions necessary to ensure that the requirements of the agreement are met. The procedures also identify specifically who is responsible for completing each action. The flow chart on page 19 graphically displays the sequence of the steps to be carried out.

As used in this summary, the "consulting parties" are the BLM and other SMA(s), the SHPO, Amoco, and the Council (if present). Other parties involved in the procedures are referred to collectively as "participants."

B. Planning Conferences

1. Prework Conference

Before fieldwork began, the lead office, SMAs, SHPO, and the applicant met to review activities related to the agreement and to reach decisions on unresolved issues. Decisions were reached and consulting parties concurred on the following issues:

a. Strategies for inventory of facilities not specifically addressed in the "Field Survey" section of this document; for example, gas processing plants, distribution pipelines, field facilities

b. Strategy for inventory to assess historic structures in relation to visual impacts

c. Methods for and levels of site recording

d. Strategies for preliminary site evaluation

e. Collection policy

f. Assignment of site numbers

g. Treatment of human remains

2. Documentation of Conference

The meeting has been documented in the Elk Basin EIS file. This file (1793-Elk Basin) will be in possession of the BLM office that is designated the lead office.

C. Data Collection

1. Introduction

Data will be collected through a Class I inventory (literature review) and a Class III (pedestrian) inventory. There will be no Class II inventory.

2. Class I Inventory: Literature Review

The CRUP will conduct a literature review for the project to accomplish the following ends:

a. Identification of previously recorded cultural resource sites within 100 feet of pipeline center lines and 50 feet of ancillary facilities. For these sites, the CRUP will take the following steps:

(1) Evaluate the adequacy of previous site recordation and of previous evaluation for eligibility for the National Register of Historic Places

(2) Plot sites on 7.5 minute USGS topographic maps, showing their relationship to the project

b. Identification of previously surveyed areas within 100 feet of pipeline center lines and 50 feet of ancillary facilities. For these surveys, the CRUP will take the following steps:

(1) Evaluate the adequacy of the survey in relation to current standards

(2) Plot survey areas on 7.5 minute USGS topographic maps, showing their relationship to the project

c. Identification of areas that may be excluded from survey because of one or more of the following factors:

(1) Slopes exceeding 40% (22° inclination)

(2) Areas of previous extensive ground disturbance (cultivated ground is not normally sufficiently disturbed to warrant exclusion)

(3) Inventory at an acceptable Class III level of intensity has previously been performed, and records adequately documenting the location, methods, and results of the survey are available.

(4) Human activity within the last fifty (50) years has created a new land surface to such an extent as to eradicate traces of cultural properties.

d. Development of a prehistorical and historical context within which all sites in the project area may be evaluated. This will include definition of property types and criteria of integrity for each type. This context will be based on the following sources and factors:

(1) Literature from the project area and surrounding geographic and culture areas

(2) Known cultural resource sites within the project area from which important information can be gained

(3) Current research goals within the region

(4) Guidelines provided by the BLM, the Keeper of the National Register, the Advisory Council on Historic Preservation, and the Secretary of the Interior

3. Class III (Pedestrian) Inventory

The CRUP will conduct an intensive (BLM Class III) pedestrian inventory (see BLM Manual, Wyoming supplement 8143).

a. Notification of Lead Office

The CRUP will notify the lead office three working days before the inventory is to begin.

b. Investigation

The following areas are to be inventoried:

(1) A 100-foot-wide corridor for access road center line

(2) A 100-foot-wide corridor where a proposed pipeline would parallel existing pipelines

(3) A 200-foot-wide corridor for any other proposed pipeline

(4) Construction zones plus a 50-foot buffer for temporary use areas and ancillary facilities

c. Recordation of Sites

All identified sites will be recorded on Intermountain Antiquities Computer System (IMACS) site forms.

(1) The CRUP will handle recordation of previously recorded sites as follows:

(a) Visit all previously recorded sites to evaluate the previous recordation, eligibility recommendation, and site integrity.

(b) Prepare IMACS site forms for previously recorded sites for which IMACS forms are not available.

(c) Prepare addenda to be incorporated into existing IMACS forms to show new data.

(2) For newly identified sites, the CRUP will proceed as follows:

(a) Record sites up to 0.25 mile from project area.

(b) Perform detailed recordation within the inventory area defined in II.C.3.b.

(c) Indicate in the report and on the site form if a site extends for more than 0.25 mile from the project area.

(3) The CRUP will record isolated artifacts on isolated artifact forms.

(4) The CRUP will plot inventory areas, sites identified, and isolated artifacts on USGS 7.5 minute topographic quad maps.

d. Notification of Completion

The CRUP will notify the lead office of the completion of fieldwork within five working days after completion.

e. Initial Evaluation of Identified Sites

The CRUP will evaluate all identified sites, completing the following steps:

(1) Comparison of the information within each site to the information needs identified in the context required in II.C.2.d. (Because of time constraints, until context is developed the CRUP is to evaluate cultural resource sites identified within the project areas in relation to criteria for the National Register of Historic Places, as defined in 36 CFR 60.4, and identified research needs.)

(2) Assessment of Eligibility for National Register.

(a) Initial assessment, placing each site in one of the following categories:

(i) Not Eligible: sufficient information is available to document that the site does not meet the eligibility criteria at 36 CFR 60.4.

(ii) Eligible: sufficient information is available to document that the site meets the eligibility criteria at 36 CFR 60.4.

(iii) Eligibility Unknown: additional information is required for an eligibility assessment (the report must include explicit justification for inclusion of each site in this category and the specific tests or other information required to assess eligibility of the sites placed in this category).

(b) Assessment of the potential of sites for buried cultural materials. The CRUP will examine existing soil exposures and use limited shovel testing, reporting in detail to the lead agency.

(c) Site summary and evaluation of each site must be provided. The following information must be included:

(i) Recommendations for additional testing for development of mitigation plan and, if necessary, determination of eligibility

(ii) Specific justification of recommendations for National Register eligibility and for any further testing or research

4. Reports

a. Reports on Literature Review

For each portion of the project area except the Elk Basin Field area, the CRUP will prepare a report documenting the results of the required literature review at II.C.2. The Elk Basin Field area was adequately covered by the Powers Elevation report (1981); the only additional information that needs to be covered by a literature review for that area is information on historical resources.

The CRUP will submit to the lead office five copies of a first draft of the final report for each project portion, with maps and illustrations. Each final report must include the following information:

(1) Identification of previously recorded cultural resource sites within 100 feet of the center lines of pipelines and within 50 feet of ancillary facilities

(a) The adequacy of previous site recordation and of previous evaluation for National Register eligibility must be assessed in relation to current standards.

(b) Sites must be plotted on 7.5 minute USGS topographic maps, and their relationship to the project must be shown.

(2) Identification of previously surveyed areas within 100 feet of the center lines of pipelines and within 50 feet of ancillary facilities

(a) The adequacy of the survey must be evaluated in relation to current standards.

(b) Survey areas must be plotted on 7.5 minute USGS topographic maps, with their relationship to the project shown.

(3) Identification of areas that may be excluded from survey because of one or more of the following factors:

(a) Slopes exceeding 40% (22° inclination)

(b) Areas of previous extensive ground disturbance (cultivated ground is not normally sufficiently disturbed to warrant exclusion)

(c) Inventory at an acceptable Class III level of intensity has previously been performed, and records adequately documenting the location, methods, and results of the survey are available.

(d) Human activity within the last fifty (50) years has created a new land surface to such an extent as to eradicate traces of cultural properties.

(4) Analysis of literature about prehistoric and historic sites in the project area and surrounding geographic and culture areas. This will include definition of property types and criteria of integrity for each type.

(a) Current research goals that could be addressed in the project area must be identified.

(b) The report must identify known cultural resource sites within the project area from which important information can be obtained.

b. Reports on Field Surveys

The CRUP will document field survey activities described under II.C.3. as follows:

(1) During fieldwork, the CRUP will submit weekly oral or written reports to districts/SMAs. These reports must include information on the areas inventoried and sites identified.

(2) Within 30 calendar days after completion of fieldwork, the CRUP will submit an outline of a report on field survey activities to the lead office for approval.

(a) The lead office will obtain comments of districts/SMAs and SHPO, approve the format or develop requirements for revisions, and return it to the CRUP within 10 working days after receipt from CRUP.

(b) After the format is approved, any further revisions of format must be approved by the lead office.

(3) Five working days before the on-location meeting described in II.C.5.a, the CRUP will submit to the lead office a brief report of field survey results in tabular form. This report must include the following information:

(a) Smithsonian site numbers

(b) Description and location of sites in the project area

(c) Initial recommendations regarding eligibility for the National Register

(d) Recommendations for additional work

(e) Anticipated effects on the sites

(f) Topographic maps showing site locations in relation to project impact area

(4) Within 90 calendar days after completion of fieldwork, the CRUP will submit to the lead office five copies of a first draft of the final report on the Class III pedestrian inventory. This report must meet stipulations 4C and 7A of the agreement and provisions of the BLM Manual, Wyoming supplement 8143. (Because of time constraints, until context is developed the CRUP is to evaluate cultural sites identified within the project areas in relation to National Register criteria as defined in 36 CFR 60.4, and identified research needs.) The report submitted must include maps, illustrations, and information as follows:

(a) Typed IMACS site forms with sketch maps, artifact sketches, maps, and one original set of photos, with halftones or good quality photocopies in the remaining sets

(b) A discussion of each individual site identified, including the following information:

(i) A brief site description

(ii) An initial recommendation for National Register eligibility and justification related to the context developed in II.C.2.d. The recommendations are to be tied to National Register criteria and identified research needs until context is developed.

(iii) Anticipated impacts on the site

(iv) A brief description of additional work recommendations

(c) A detailed discussion of the prehistorical and historical context described in II.C.2.d.

(d) A detailed discussion of inventory findings, including detailed initial recommendations as to eligibility of sites for the National Register. The recommendations are to be tied to National Register criteria and identified research needs until context is developed.

(e) A detailed discussion of recommendations for additional work needed for eligibility evaluations or development of mitigation plans, or both.

(5) BLM/SMAs and SHPO will review the report and provide comments to the lead office within 20 working days after receipt from the lead office.

(6) The lead office will provide consolidated comments to the CRUP within 10 working days after comments are received from reviewers.

(7) Within 30 calendar days after the comments are forwarded to the CRUP, the CRUP will submit to the lead office six copies of a final report incorporating the revisions indicated by the comments. The report must include maps and illustrations.

c. Context Document

The CRUP will prepare a document regarding the context developed as described in II.C.2.d. The document should synthesize all available information about the project area. The following sources should be used to be prepare the context document: (a) the Class I literature review reports for the individual oil fields covered in the EIS for the Amoco carbon dioxide projects, (b) the class III reports for the Elk Basin and Beaver Creek trunk line alternatives and the Fontenelle plant site, (c) any other pertinent information.

(1) The CRUP will submit five copies of the first draft of a final report to the lead office, with maps and illustrations.

(a) The report, which will address current research goals for prehistoric sites and current historical contexts in the region, will be based on the following sources and factors:

(i) Literature from the project area and surrounding geographic and culture areas

(ii) Guidelines provided by the BLM, the Keeper of the National Register, the Advisory Council on Historic Preservation, the Wyoming SHPO, and the Secretary of the Interior

(iii) State historical contexts

(b) The report will evaluate the following factors for all known sites in the project area:

(i) Eligibility for inclusion on the National Register

(ii) The relationship of each to other sites in the project area

(iii) The interpretive value of each site for public education

(2) BLM/SMAs and SHPO will review the report and provide comments to the lead office within 20 working days after receipt from the lead office.

(3) The lead office will provide consolidated comments to the CRUP within 10 working days after comments are received from reviewers.

(4) Within 30 calendar days after the comments are forwarded to the CRUP, the CRUP will submit to the lead office six copies of a final report incorporating the revisions indicated by the comments. The report must include maps and illustrations.

5. Meetings

a. Within 30 calendar days after completion of fieldwork, the consulting parties will have a tour meeting. The meeting will enable the parties to visit sites identified during the inventory that have been initially recommended as eligible for the National Register and sites classified as "eligibility unknown." Alternate pipeline routes to avoid cultural resources will be considered and discussed during this meeting. The parties also may visit other sites that the BLM/SMAs or SHPO staff want to see. The summary report required in II.C.4.b. is a prerequisite to this meeting.

b. Within 20 working days after the draft report on the Class III inventory is received from the CRUP, the BLM/SMAs and SHPO may meet to discuss comments on the report. In any case, the lead office will then consolidate the comments of all parties and forward them to the CRUP.

c. The lead office may arrange a meeting with the CRUP and consulting parties if major revisions to the draft report are required.

D. Proposed New Routes, and Testing

1. Proposed New Routes

The CRUP will conduct a Class III inventory on proposals for new routes and report on them in accordance with section C, "Data Collection."

2. Testing

a. Preparation of Testing Plans

(1) Plan based on Report of Field Survey

On the basis of recommendations in the report on field surveys, the consulting parties and participants will develop a testing plan within 30 calendar days after the final report is accepted. The plan will include the following decisions:

(a) Sites to be tested

(b) Methods to be used

(c) Analyses to be conducted on recovered materials

(d) Approximate volume of excavations to be conducted

(e) Content of testing report

(2) Plan Based on Report of Inventory of Proposed New Routes

On the basis of recommendations in the report on the inventory of proposed new routes, the consulting parties and participants will develop a testing plan within 30 calendar days after the final report is accepted. The plan will include decisions about the five activities listed in II.D.2.a.(1), above.

b. Implementation of Testing Plans

(1) The CRUP will notify the lead office and the districts/SMAs of intent to start work at a site three working days before fieldwork begins.

(2) The CRUP will implement the approved testing plan based on the report of field survey activities.

(3) The CRUP will implement approved testing plan based on the report or inventory of proposed new routes.

(4) The CRUP will notify lead office and districts/SMAs of completion of work at a site within five working days after the work is completed.

3. Reports

a. The CRUP will provide weekly oral or written reports describing the work accomplished and preliminary findings.

b. Within 30 calendar days after fieldwork is completed, the CRUP will submit an outline of the testing report, which will incorporate results of the testing plans described in II.D.2.a. and b.

c. The lead office will obtain comments of districts/SMAs and SHPO, approve the format or develop requirements for revisions, and return it to the CRUP within 10 working days after receipt from CRUP. After the format is approved, any further revisions of format must be approved by the lead office.

d. Within 90 calendar days after completion of fieldwork, the CRUP will submit five copies of a first draft of the final testing report to the lead office, with maps and illustrations. The report must incorporate results of the testing plans described in II.D.2.a.

e. BLM/SMAs and SHPO will review the report and provide comments to the lead office within 20 working days after receipt from the CRUP.

f. The lead office will provide consolidated comments to the CRUP within 30 working days after receipt.

g. Within 30 calendar days after the comments are forwarded to the CRUP, the CRUP will submit to the lead office six copies of a final report incorporating the revisions indicated by the comments.

4. Meetings

a. The consulting parties may need to meet to develop the testing plan described at II.D.a.(1), which is to be based on the report of field survey activities described in II.C.4.b.

b. The consulting parties may need to meet to develop the testing plan based on the report on the inventory of proposed new routes described in II.D.2.a.(2).

c. BLM/SMAs and SHPO may meet to discuss and consolidate the comments on the draft testing report within 20 working days after receipt of the report from the CRUP.

d. The lead office and consulting parties may meet with the CRUP if major revisions are required on the draft report.

E. Mitigation

1. Procedures

a. Preparation of Treatment Plan

Within 60 calendar days after receipt of the final testing report, the consulting parties and participants will develop a treatment plan for mitigation. The plan should be based on the recommendations in the reports of the field surveys, proposed new routes, testing, and trench inspection. (Private landowners may be considered interested parties for the development of treatment plans for properties on their land.) The treatment plan must include information required in stipulation 4C of the MOA.

(1) The plan will identify sites at which data recovery measures will be implemented and include the following specifications.

(a) Methods of data recovery to be used (for example, HABS/HEAR, artifact collection, archival research)

(b) Analysis to be conducted on recovered materials

(c) Approximate volume of excavations, if excavations are proposed

(2) The plan will identify sites at which avoidance measures will be implemented and specify the following practices.

(a) Types of avoidance measures to be used

(b) Methods for documentation of results

(3) The plan will identify areas subject to trench inspection in accordance with stipulation VI of the MOA. It will include discussion of each type of feature that is expected to be encountered, and for each type the following practices will be specified.

(a) Methods of recordation and documentation to be used

(b) Standards for data recovery

(c) Analysis to be conducted on recovered materials

(4) The plan will identify areas subject to monitoring of construction work in accordance with stipulation V of the MOA.

(5) The plan will identify any other mitigation strategies (for example, fencing, road closures).

(6) The plan will include an outline of the content of the mitigation report to be prepared by the CRUP (including synthesis of all project-related findings).

(7) The consulting parties and participants will prepare an addendum to the plan that describes mitigative measures required for properties discovered during monitoring and trench inspections.

b. Implementation of Treatment Plan

The CRUP will implement the treatment plan.

(1) The CRUP must notify the BLM/SMA three working days before beginning work at a site.

(2) Within five working days after fieldwork at a site is finished, the CRUP must notify the BLM/SMA of completion.

c. Identification of Cultural Properties Discovered

The CRUP will identify any cultural properties discovered during monitoring and trench inspection that will require additional mitigative work.

d. Recommendations for Further Work

Recommendations for further work will be based on the context document described at II.C.2.d.

2. Reports

   a. The CRUP will provide weekly oral or written reports describing the work accomplished and the preliminary findings.

   b. Within 30 calendar days after fieldwork is completed, the CRUP will submit to the lead office an outline of the mitigation report, which will incorporate results of implementation of the treatment plans described in II.E.1.a.

   c. The lead office will obtain comments of districts/SMAs and SHPO, approve the format or develop requirements for revisions, and return it to the CRUP within 20 working days after receipt from CRUP. After the format is approved, any further revisions of format must be approved by the lead office.

   d. Within 180 calendar days after completion of fieldwork, the CRUP will submit five copies of a first draft of the final mitigation report to the lead office, with maps and illustrations. The report must incorporate results of implementation of the treatment plans described in II.E.1.

   e. BLM/SMAs and SHPO will review the report and provide comments to the lead office within 60 working days after the report is received from the CRUP.

   f. Within 70 working days after receiving the report from the CRUP, the lead office will provide consolidated comments to the CRUP.

   g. Within 30 calendar days after the comments are forwarded to the CRUP, the CRUP will submit to the lead office six copies of a final report incorporating the revisions indicated by the comments.

   h. Within 20 working days after submitting the final mitigation report, the CRUP will submit to the district/SMAs complete documentation of curation and a record of the disposition of federally and privately owned cultural materials.

   i. The lead office will report to the Advisory Council on Historic Preservation as per stipulation 15 of the MOA.

3. Meetings

   a. Consulting parties and participants will meet to develop the treatment plan for mitigation.

b. Within 60 working days after the draft mitigation report is received, the BLM/SMAs and SHPO may meet to discuss the report and consolidate the comments to be provided to the CRUP.

c. The consulting parties may meet with the CRUP if the draft report will require major revisions.

III. PROVISIONS FOR ADDENDA

A. If necessary, addenda to this "Roles and Procedures" document may be developed for major subcomponents of this project (such as individual fields and trunk lines).

B. An addendum may be proposed by any of the consulting parties; however, implementation requires concurrence in writing by all consulting parties.

IV. Concurrence Signatures

Bureau of Land Management

By: James M Monroe Date: Aug. 16, 1988
Name: Jim Monroe
Title: Casper District Manager

Wyoming State Historic Officer

By: Thomas E Marceau Date: 8/16/88
Name: Tom Marceau
Title: Deputy SHPO, Programs

Bureau of Reclamation

By: Bill Martin Date: 9-15-88
Name: Bill Martin
Title: Regional Director

Amoco Production Company

By: Dale D. Gilliam Date: 8/18/88
Name: Dale D. Gilliam
Title: Regional Production Manager

Advisory Council on Historic Preservation

By: Date: 8.17.88.
Name: ~~Robert Fink~~
Title: Chief, Western Division of Project Review
Acting

FLOW CHART

AMOCO CARBON DIOXIDE PROJECTS

CULTURAL RESOURCE USE PERMITTEE

CONSULTING PARTIES

(Bureau of Land Management, Bureau of Reclamation, Advisory Council on Historic Preservation, Wyoming State Historic Preservation Office, and Amoco Production Company)

Permittee: Conduct literature review; prepare report and recommendations.
Conduct Class III inventory; prepare report and recommendations.
Develop context; prepare report and recommendations.

Consulting Parties: Review reports and recommendations; develop requirements for revision

Permittee: Revise reports and recommendations according to requirements

Consulting Parties: Accept completed reports and recommendations

Consulting Parties: Develop testing plans

Permittee: Implement testing plans; prepare report(s) and recommendations

Consulting Parties: Review report(s) and recommendations; develop requirements for revision

Permittee: Revise reports and recommendations according to requirements

Consulting Parties: Accept completed report(s) and recommendations

Consulting Parties: Develop overall treatment plan for mitigation. In addition, create detailed addendum specifying procedure for monitoring and trench inspection

Permittee: Implement monitoring and trench inspection; prepare report(s) and recommendations

Consulting Parties: Review report(s) and recommendations; develop requirements for revision

Permittee: Revise reports and recommendations according to requirements

Consulting Parties: Accept completed report(s) and recommendations

Consulting Parties: Create detailed addendum to treatment plan specifying procedure for mitigation excavations

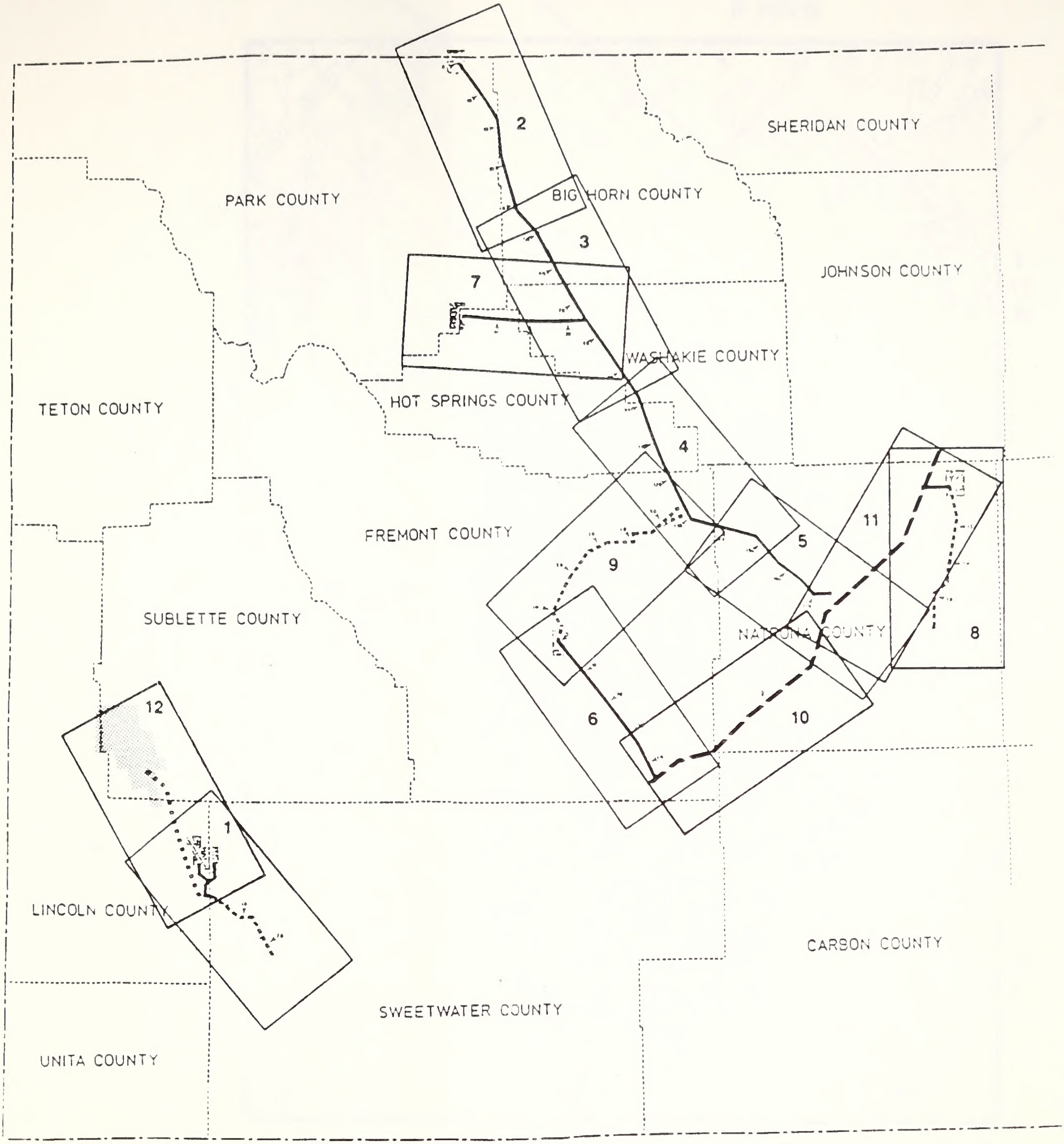
Permittee: Implement mitigation excavations; prepare report(s)

Consulting Parties: Review report(s); develop requirements for revision

Permittee: Revise report(s) according to requirements

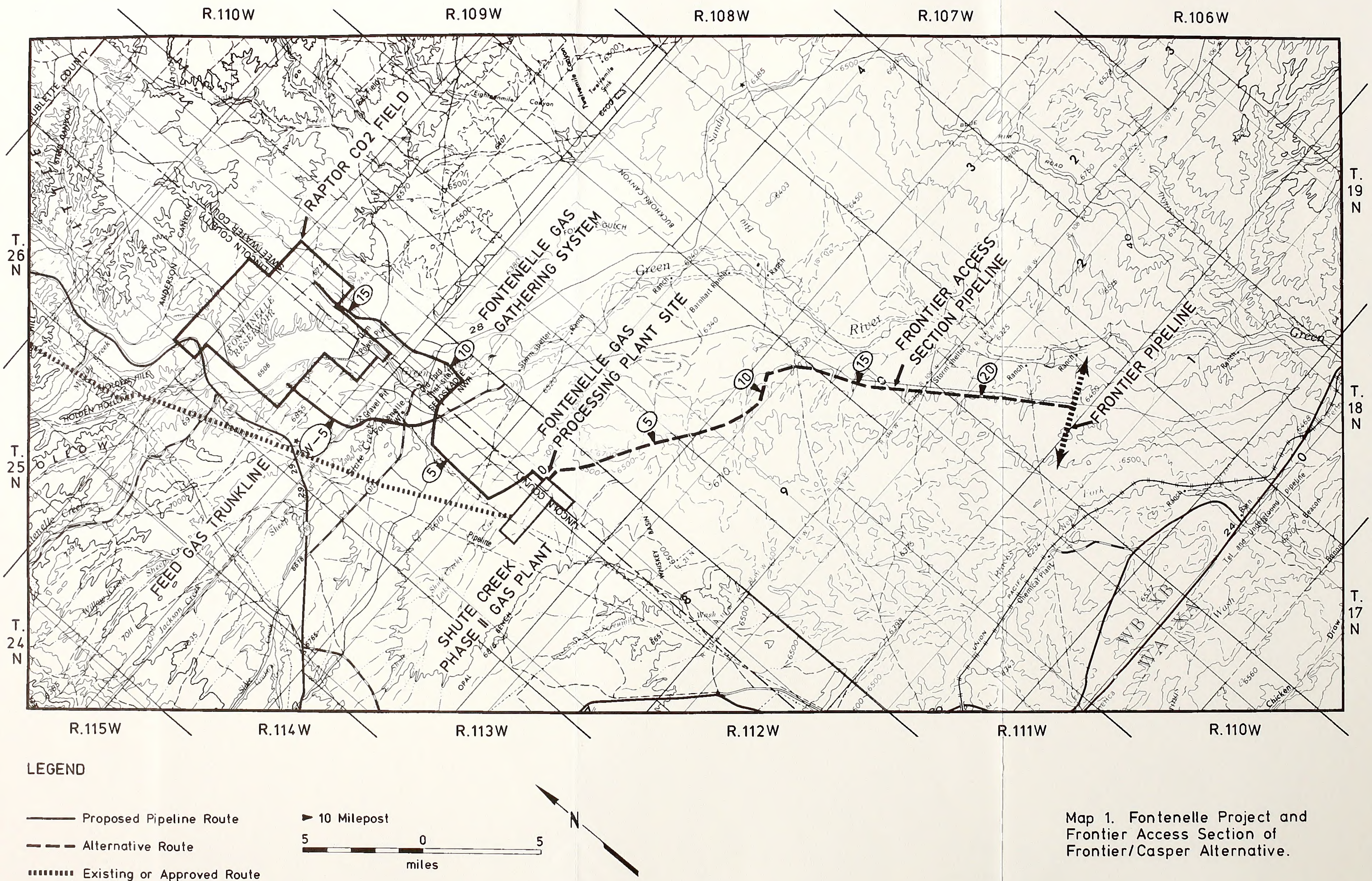
Consulting Parties: Accept completed final report(s)
Prepare report to Advisory Council on Historic Preservation about actions taken under agreement

APPENDIX 4
MAPS

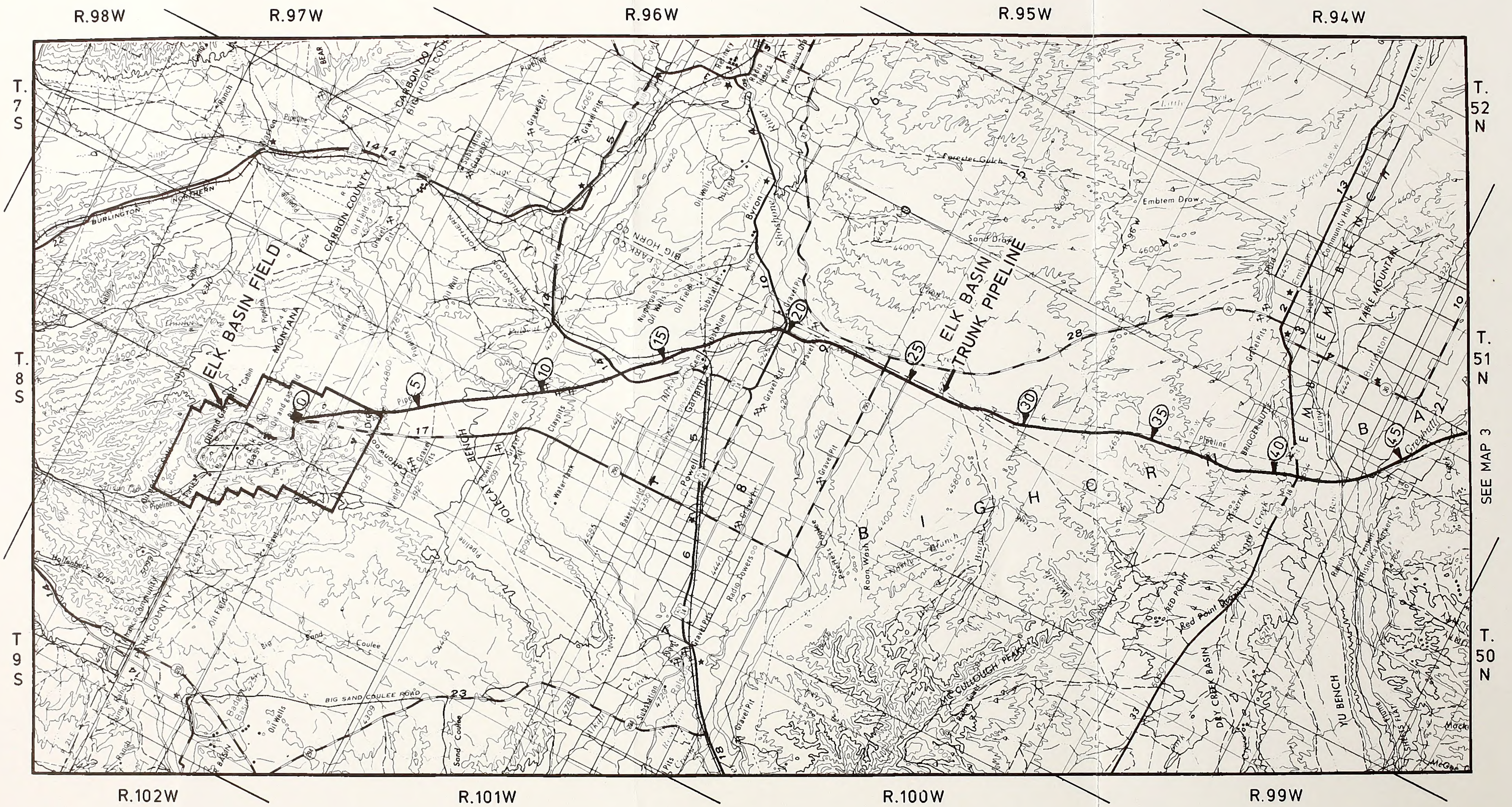


1 FONTENELLE
FRONTIER ACCESS SECTION
2-5 ELK BASIN
6 BEAVER CREEK
7 LITTLE BUFFALO
8 SALT CREEK
CASPER SECTION
9 BEAVER CREEK ALTERNATIVE
12 EXXON ALTERNATIVE CO_2 SUPPLY
10,11 PROPOSED BAIROIL/DAKOTA

INDEX FOR MAPS 1—12



Map 1. Fontenelle Project and Frontier Access Section of Frontier/Casper Alternative.



LEGEND

- Proposed Pipeline Route
- Alternative Route
- Existing or Approved Route

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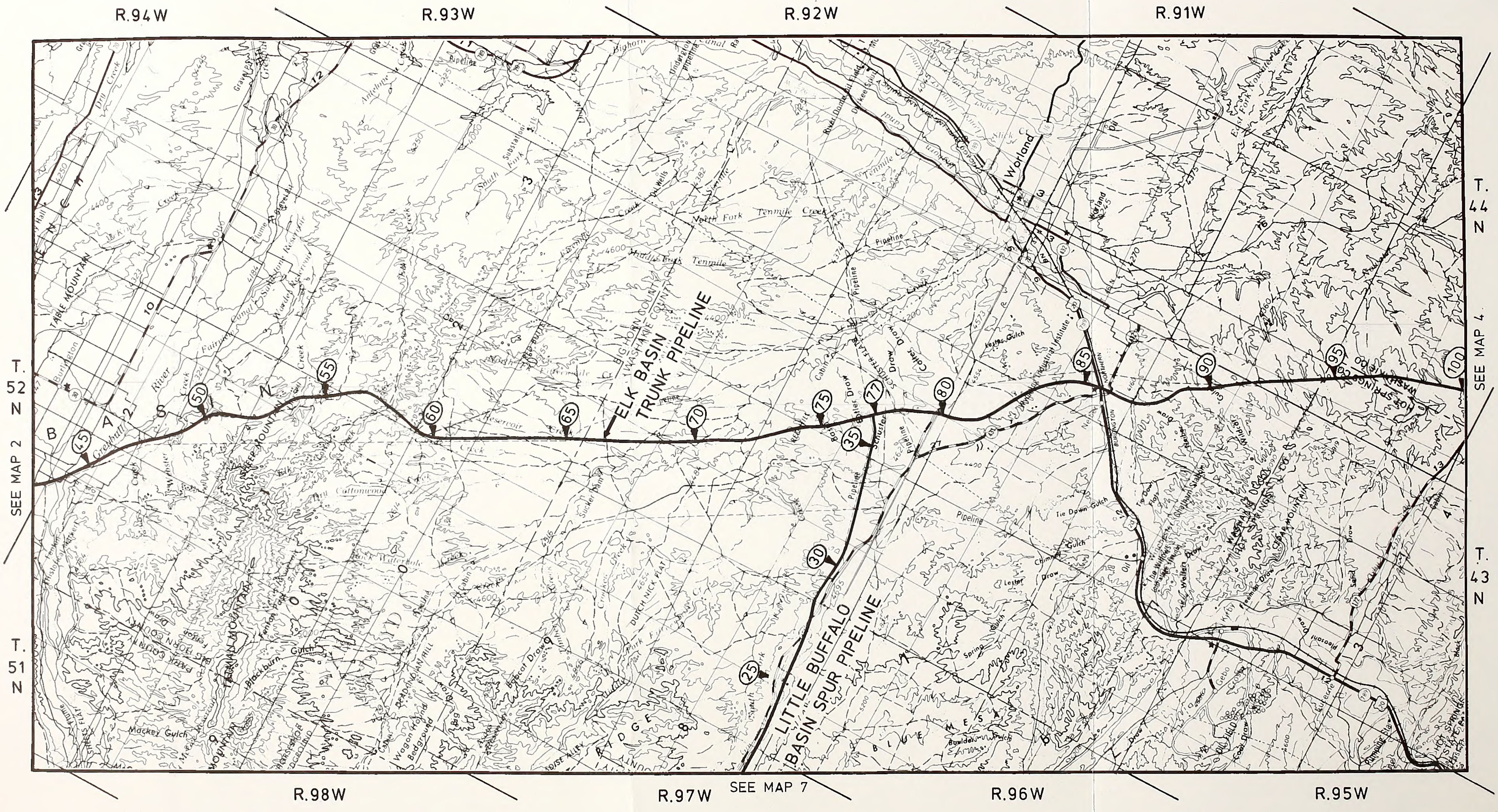
miles

N

Map 2. Elk Basin Trunk Pipeline



LEGEND

———	Proposed Pipeline Route
— — —	Alternative Route
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miles

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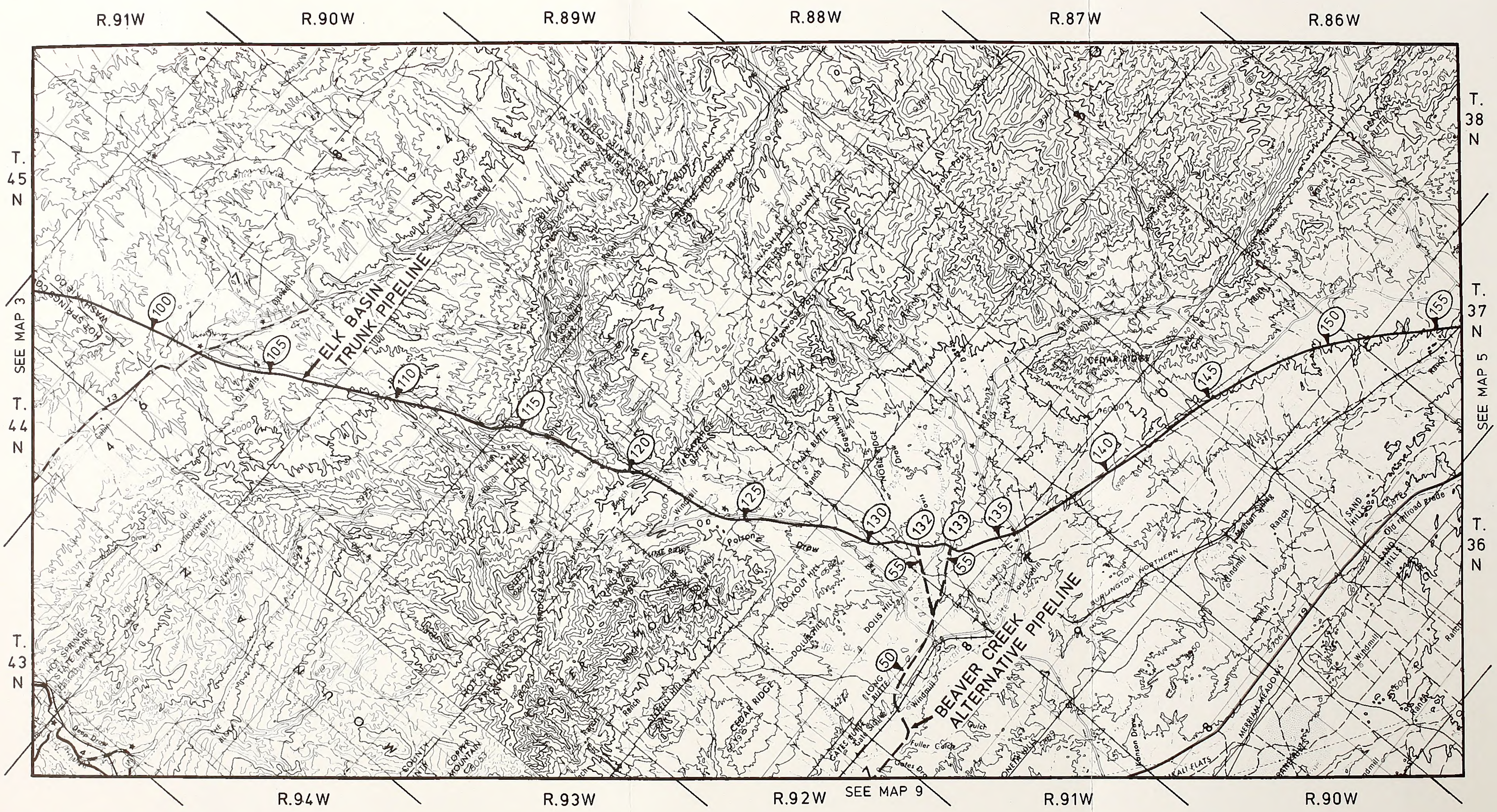
Map 3. Elk Basin Trunk Pipeline.



LEGEND

——— Proposed Pipeline Route

— — — Alternative Route

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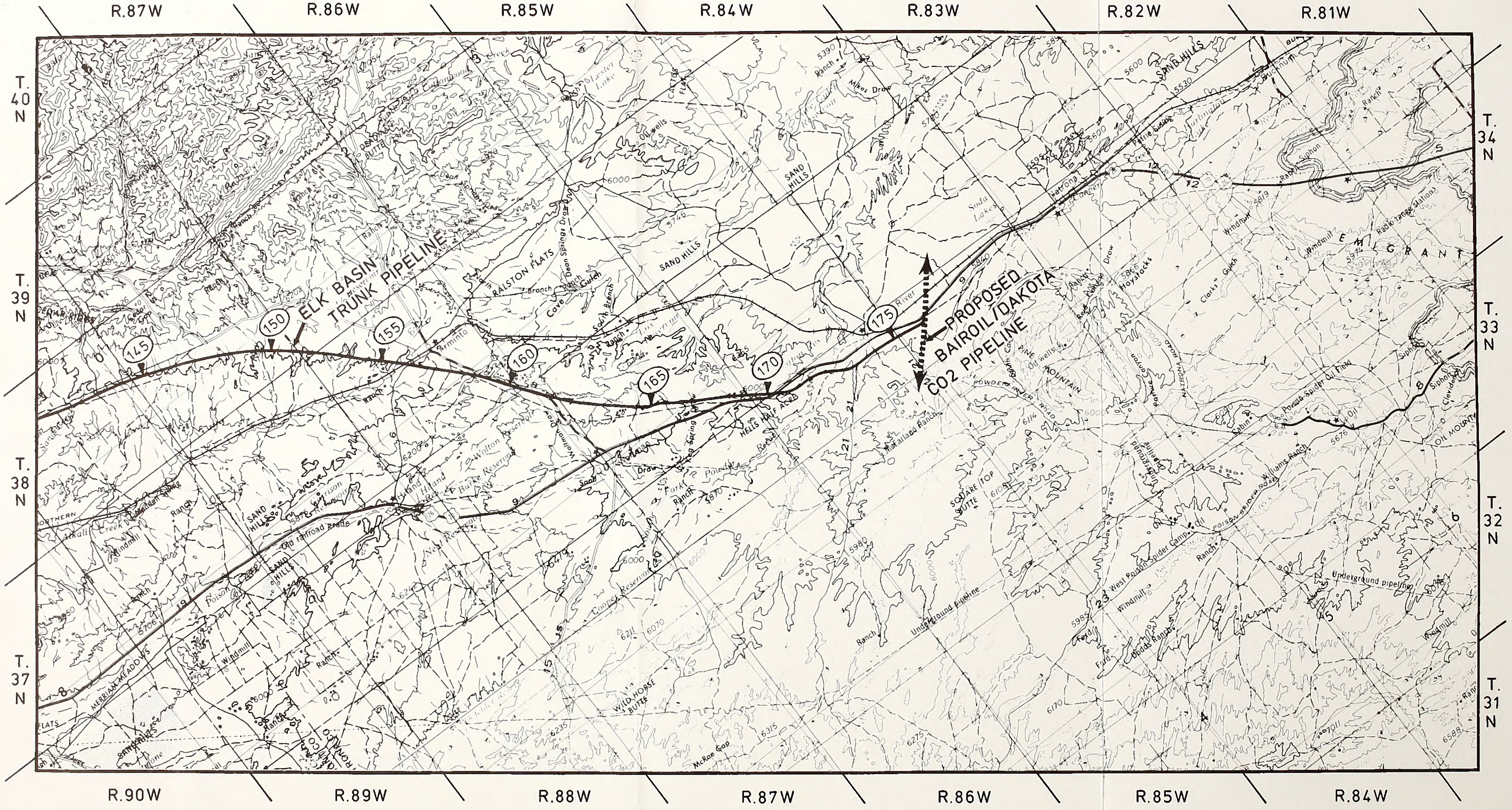
Map 4. Elk Basin Trunk Pipeline.



LEGEND

—— Proposed Pipeline Route

— — — Alternative Route

▪▪▪▪▪▪ Existing or Approved Route

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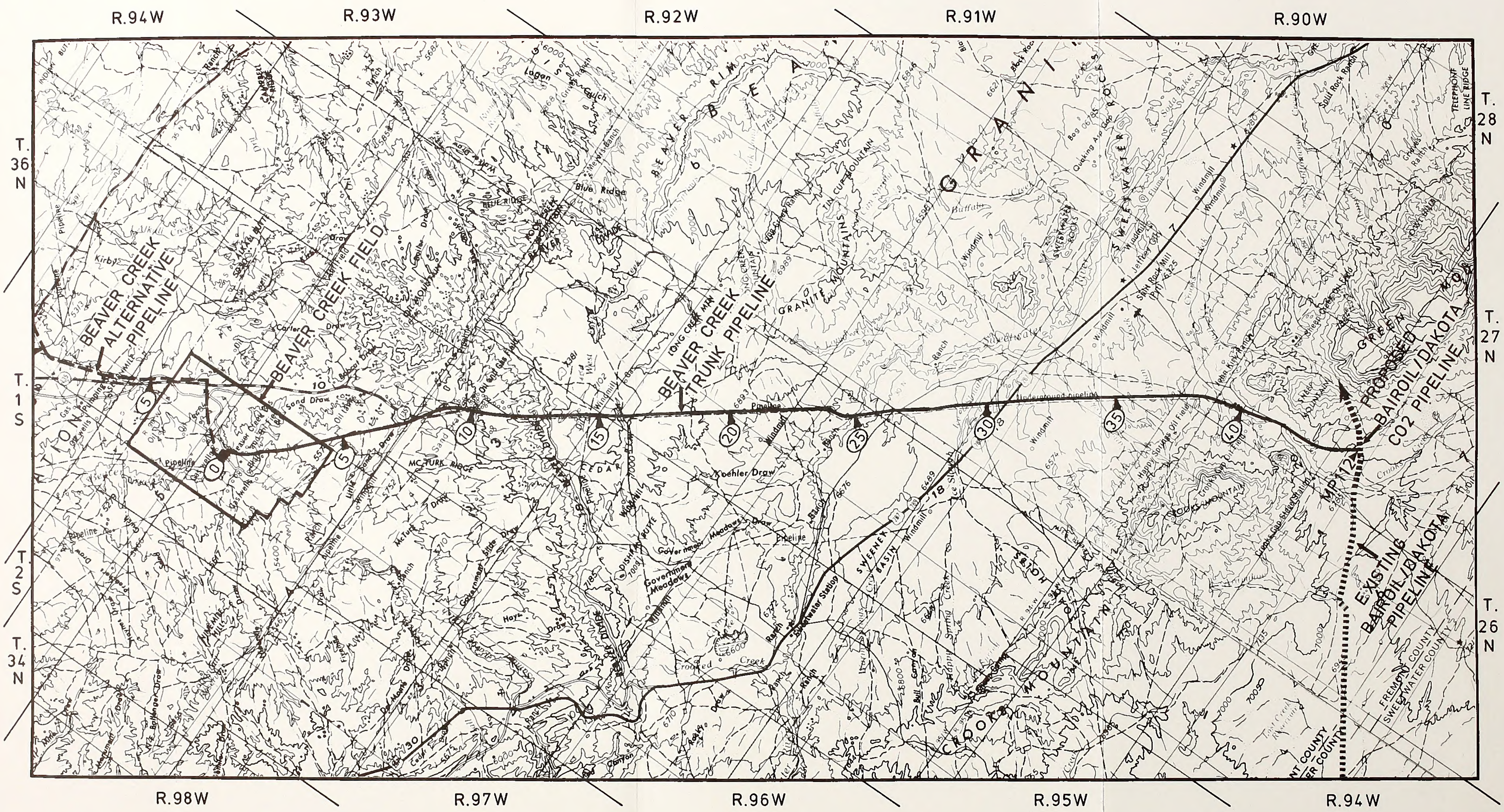
Map 5. Elk Basin Trunk Pipeline.



LEGEND

Proposed Pipeline Route

Alternative Route

Existing or Approved Route

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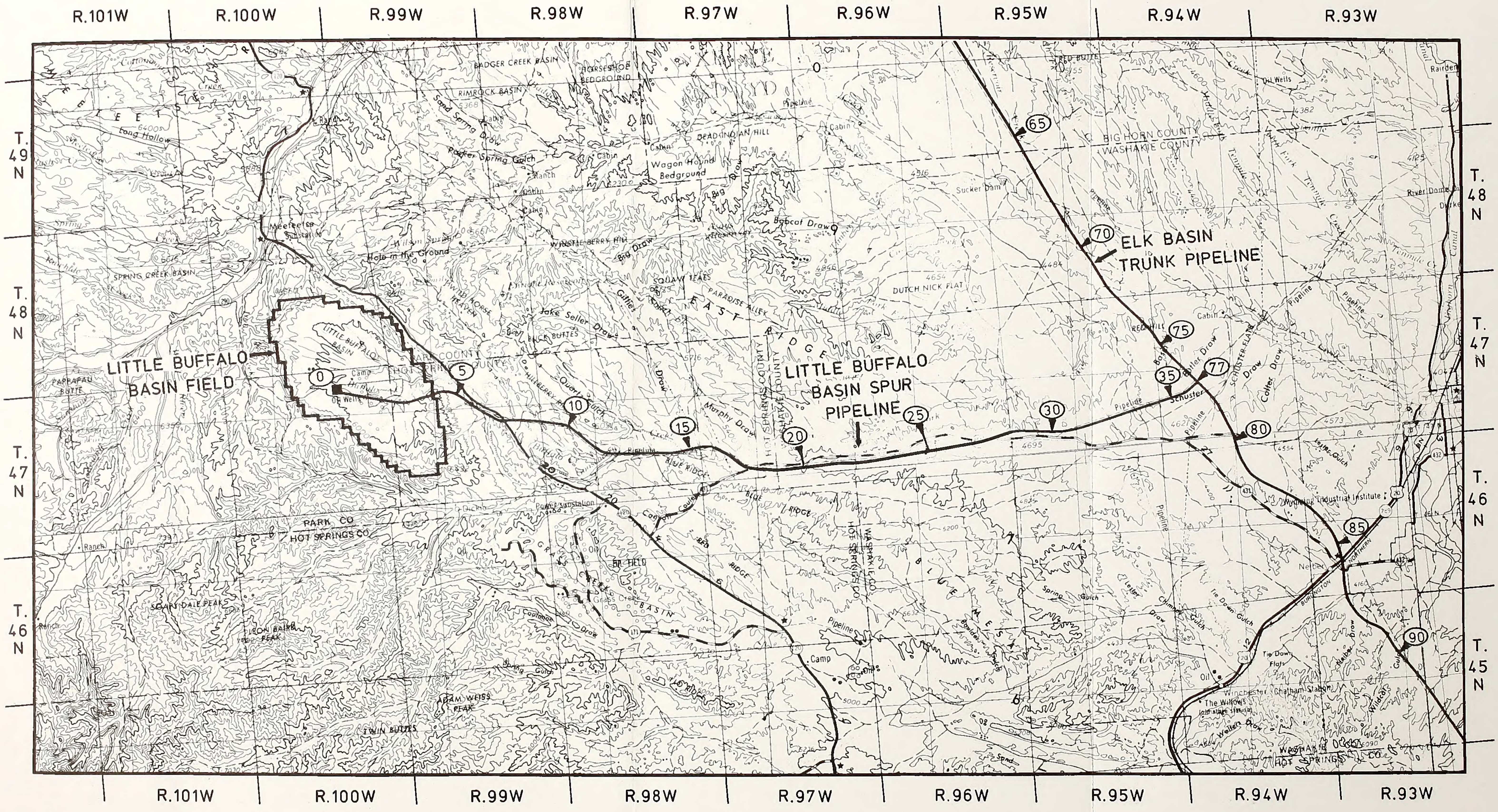
Map 6. Beaver Creek Project.



LEGEND

- Proposed Pipeline Route
- Alternative Route
- Existing or Approved Route

► 10 Milepost

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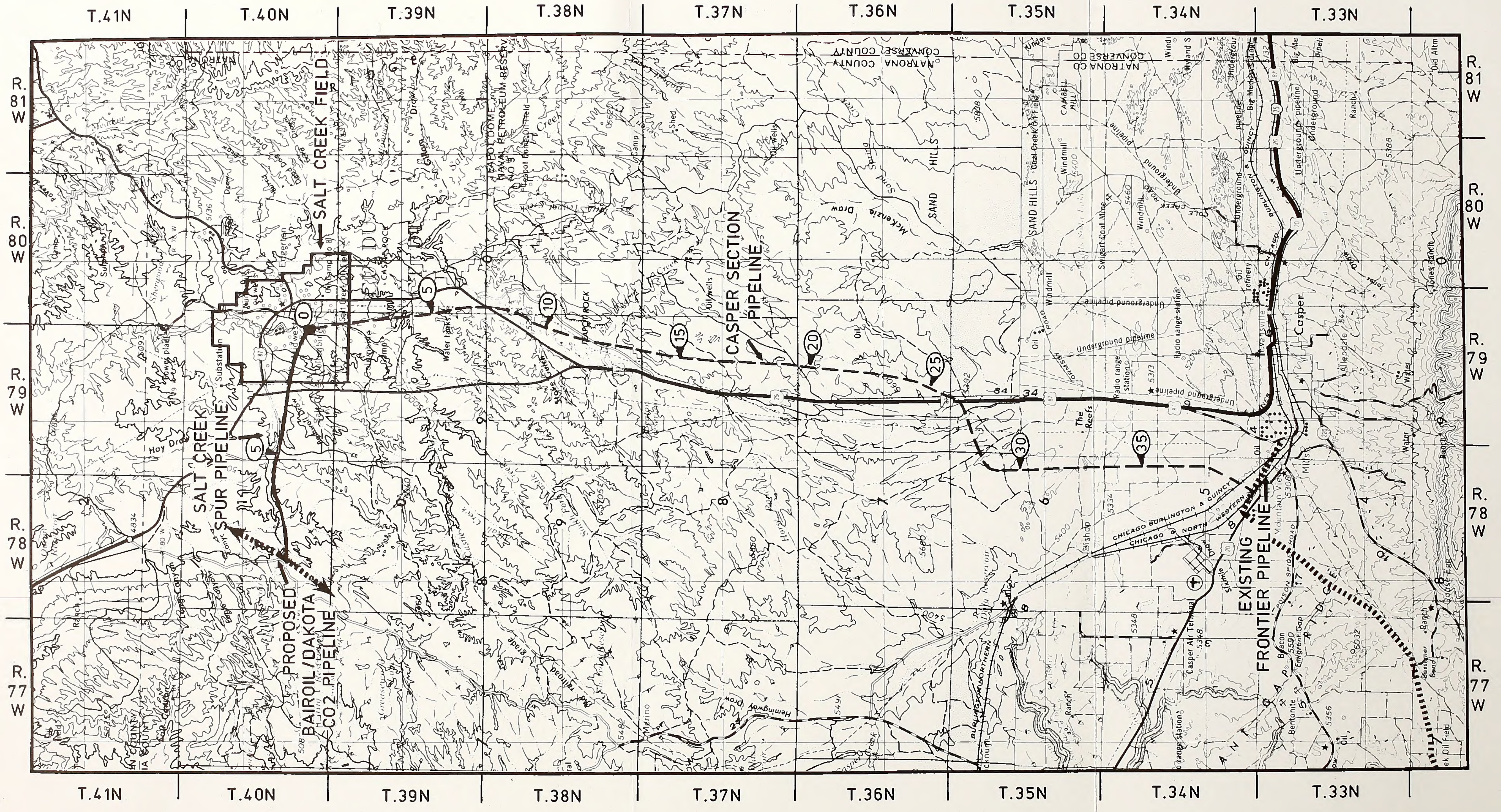
miles

N

Map 7. Little Buffalo Basin Project.



LEGEND

—— Proposed Pipeline Route

– – – Alternative Route

▪▪▪▪▪▪▪▪ Existing or Approved Route

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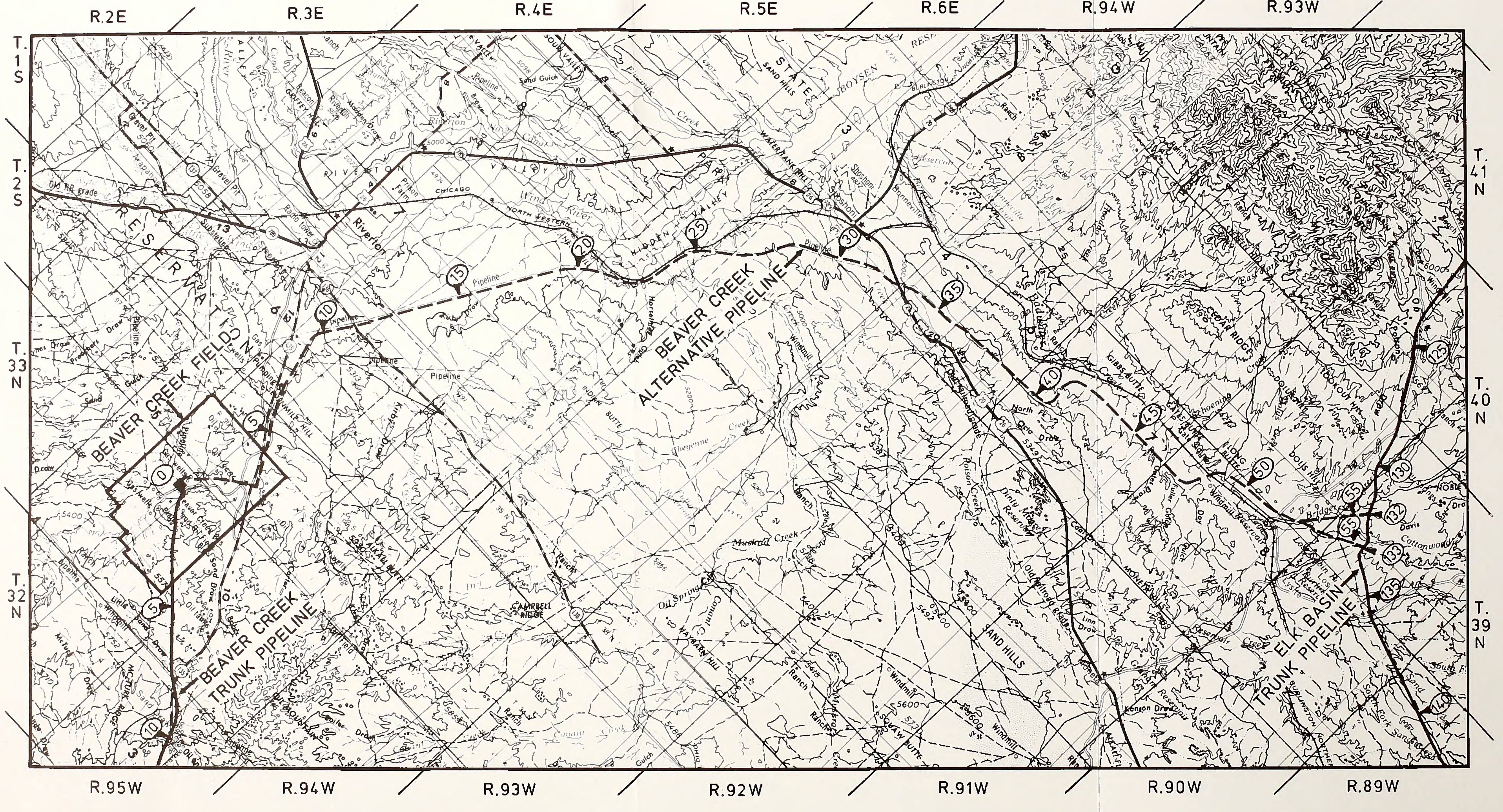
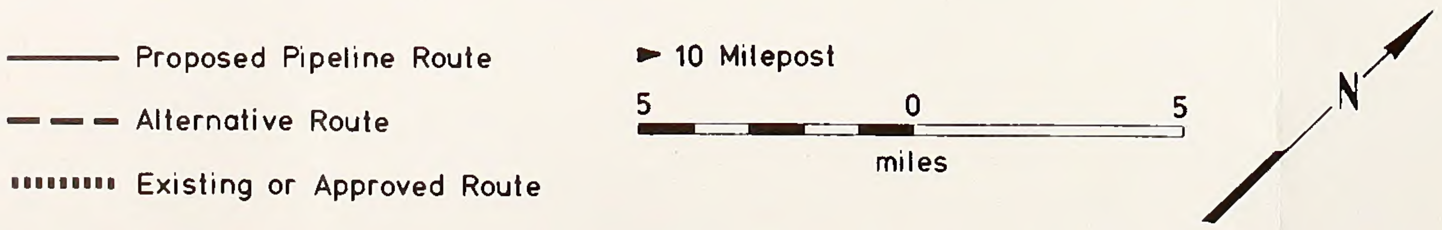
← N

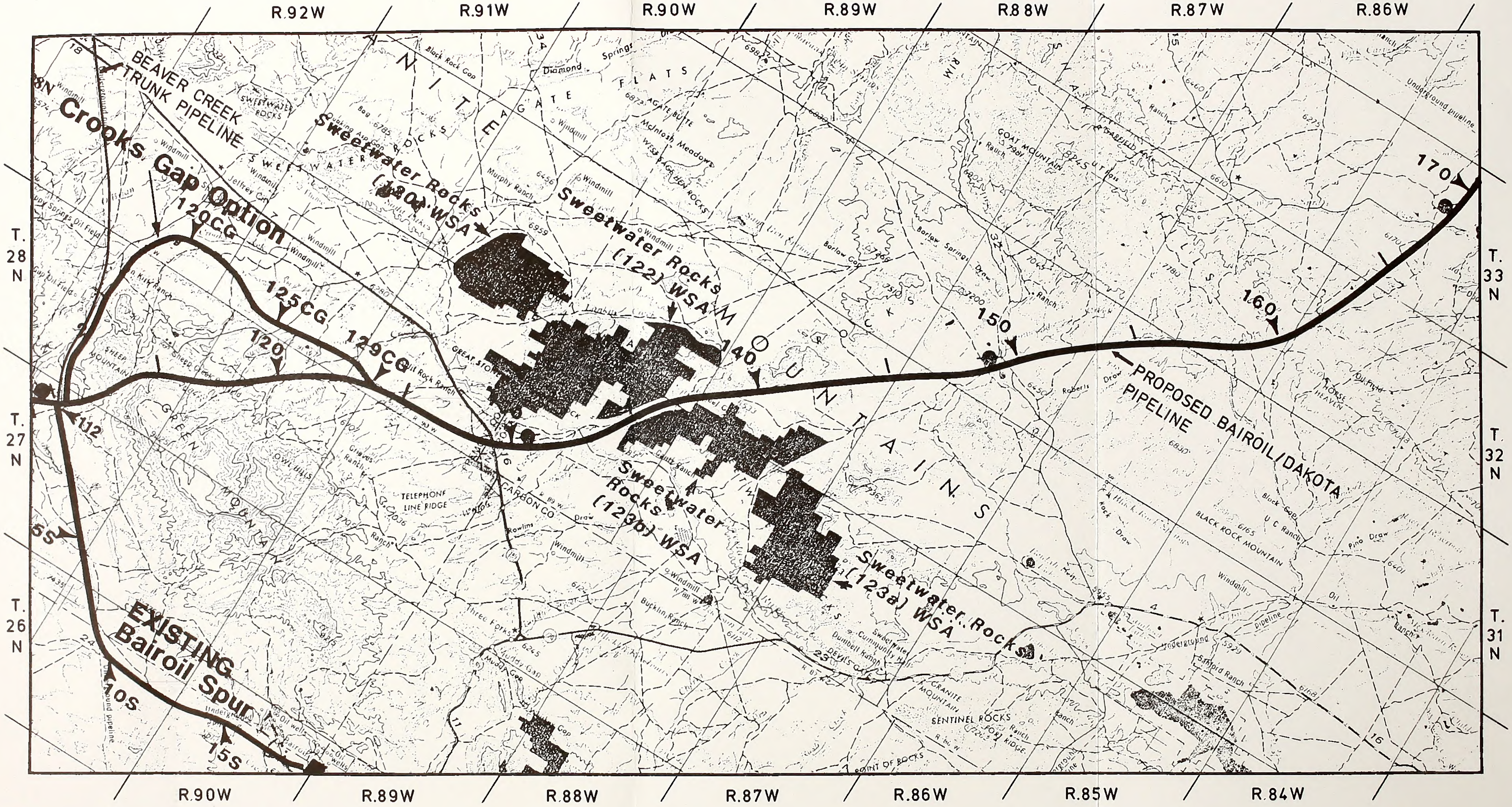
Map 8. Salt Creek Project and Casper Section of Frontier/Casper Alternative.



LEGEND



Map 9. Beaver Creek Alternative.



LEGEND

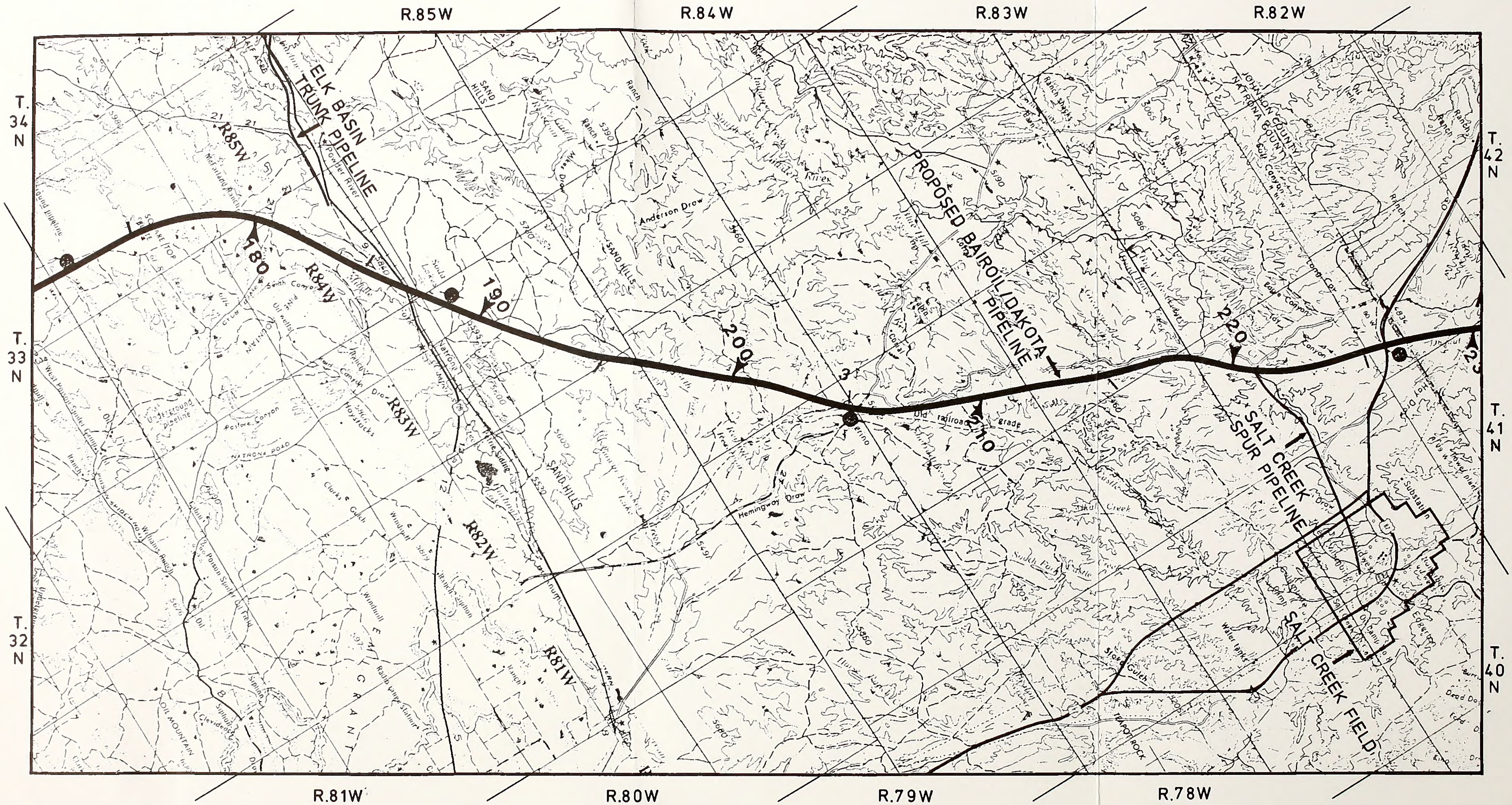
———	Proposed Pipeline Route
– – –	Alternative Route
▬▬	Bairoil/Dakota Pipeline

► 10 Milepost

5 0 5
miles

N

Map 10. Exxon's Proposed Bairoil/Dakota Pipeline.



LEGEND

Proposed Pipeline Route

Alternative Route

Bairoil/ Dakota. Pipeline

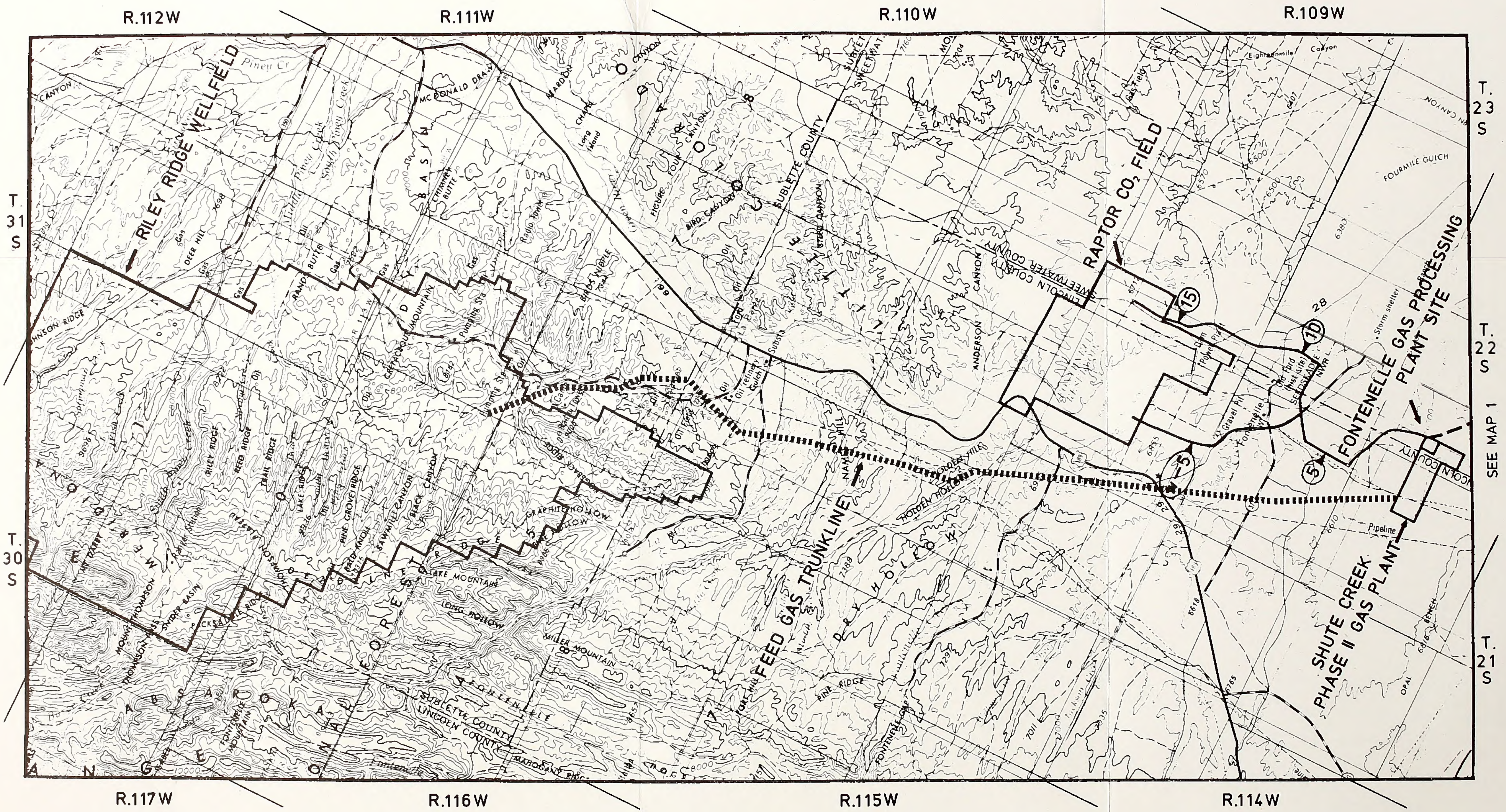
10 Milepost

5 0 5

miles

N

Map 11. Proposed Bairoil/Dakota Pipeline.



LEGEND

———	Proposed Pipeline Route
— — —	Alternative Route
▮▮▮▮▮▮▮▮	Existing or Approved Route
► 10	Milepost

5 0 5
miles

N

Map 12. Exxon Alternative CO2 Supply.